Monitoring and management of tourist landing sites in the Maritime Antarctic

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This thesis represents my own original work and conforms to accepted standards of citation in those instances in which I have availed myself of the work of others.

This thesis is not now being submitted, nor has been submitted in the past, for any degree, diploma, or similar qualification at any university or similar institution.

This thesis does not exceed the maximum allowable length of 250 pages, including footnotes, appendices and references, and excluding tables.

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May, 1998.

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Scientific Committee for Antarctic Research Bird Biology Subcommittee (SCAR-BBS) 1996. *The status and trends of Antarctic and Subantarctic seabirds*. Report to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR). Hitherto unpublished data and comments towards the assessment of gentoo penguin status for IUCN taxon data sheet were contributed.

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Monitoring and management of tourist landing sites in the Maritime Antarctic

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Tourism is the most recent large-scale human activity in the Antarctic. The 1991 Protocol on Environmental Protection to the Antarctic Treaty requires that all activities in the Antarctic, including tourism, shall *"be planned on the basis of information sufficient to allow prior assessments of, and informed judgements about their possible impacts... and ...regular and effective monitoring shall take place to allow assessments of the impacts of ongoing activities."* As yet there is an acknowledged lack of hard data on the effects of tourism on the Antarctic environment, and no such monitoring programme exists.

Because of its scale and environmental context, shipborne tourism is likely to disturb Antarctic ecosystems. 96.5% of all Antarctic tourists are shipborne and over 90% of their visits are to the Maritime Antarctic (Antarctic Peninsula and South Orkney and South Shetland Islands), Antarctica's ecologically richest area. This study is founded on the author's five years of research, both at a field station and as a shipboard expedition leader. The programme formed part of a longer study of polar tourism, Project Antarctic Conservation, directed by Dr Bernard Stonehouse of the Scott Polar Research Institute, University of Cambridge.

Assessing three phases of shipboard operation — on the ship, in landing craft, and ashore — operations ashore were found to be the most difficult to quantify and likely to show cumulative effects from repeated small perturbations. Thus, landing operations and sites became the main focus of investigation. Three major research objectives were: (1) to examine patterns in landing site use, based on NSF/IAATO data; (2) to assess the industry's landing site organisation and site selection procedures based on field experience; and (3) to investigate ecological disturbance from tourist visits at a popular landing site: for this Cuverville Island (64°41`S, 62°38`W) was selected and studied for three consecutive seasons 1992–95.

A total of 128 landing sites were identified, clustered into five geographic areas, and found to differ widely in physical characteristics, level of use and ecological vulnerability. Trends in numbers of passenger, voyages, sites visited etc., over the past decade, were examined. Each voyage involves visits to several sites, to show tourists a range of environments and wildlife. Small vessels, carrying fewer passengers on shorter voyages, have recently come into vogue, each vessel making more voyages per season. Yet, as the number of landings per voyage has not decreased, a recent slight decrease in the annual number of passengers, has not resulted in a proportionate decrease in the number of landings per season.

Landing operations are generally competent, safe and environmentally sensitive. However, there is no generally-accepted measure of site vulnerability, and no formal recognition that sites vary in sensitivity; the industry's own recommendations for site management are uniform for all sites. Expedition leaders, who ultimately decide which sites are visited, vary widely in awareness of differences in site vulnerability, but are left to develop their own visitor management strategies at individual sites, based on personal perceptions. Thus, management of landing sites, insofar as it exists at all, is informal, and undertaken by individuals within the industry.

Ecological studies of Cuverville Island are described and analysed. Visits were on the whole well managed, and team research under the author's field leadership revealed few measurable adverse effects on local breeding populations of wildlife. However, possibilities exist for long-term impacts arising from repeated use. From these studies have been developed key management parameters for assessing visitor impact, and designing effective measures for long-term monitoring of vulnerable sites.

The author concludes that, for effective long-term management of sites, management objectives must be defined, and variations in sensitivity and vulnerability recognised. Sites that appear to be at risk from shipborne tourism must be assessed individually. The dissertation proposes site monitoring objectives, practical methods for site assessment, and a framework for long-term monitoring and management programmes, that are both consistent with the requirements of the Protocol, and appropriate for practical implementation.

Acknowledgements

This dissertation covers several disciplines and fields of interest. Consequently many individuals and organisations have contributed to the approach adopted, and ideas expressed, here. Sincere thanks are due to all who have helped in the research and preparation of this dissertation.

My supervisor, Dr. Bernard Stonehouse, has given much time and effort to this study; I am indebted to him for academic help and personal support prior to, and throughout, the preparation of this dissertation. I am grateful to Darrel Schoeling of the International Association of Antarctica Tour Operators (IAATO), and the IAATO executive committee (Denise Landau, Victoria Underwood and Barbel Kramer) and the IAATO spokesperson (John Splettstoesser) who provided data and information, enabled my participation in meetings and workshops pertinent to this work, and gave long-standing support to this work. Nadene Kennedy of the National Science Foundation Office of Polar Programs made data available on frequency of site visits. Aerial photography was provided by the British Navy and the Hydrographic Office. At British Antarctic Survey, Dr Barry Haywood, Director, and Joanna Rae, archives, enabled access to the Faraday Base Leaders reports. Helpful comments and suggestions on this work have been made by Dr Peter Clarkson, Dr. Norman Cobley, Dr. Pam Davis, Robert Headland, Joyce Jatko, Dr Margaret Johnston, Dr Maj de Poorter, David Rootes, Dr John Shears, and, in particular, by Dr Amanda Nimon and Dr Sandy Crosbie. Both Robert Headland and Ailsa McQueen kindly proof-read this dissertation.

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Fieldwork for this dissertation was completed on Cuverville Island *(64°41'S 62°38'W)* and onboard expedition vessels. On Cuverville Island, in addition to the financial support listed above, various articles of equipment were donated or lent by: the Geography Department, University of Edinburgh, the British Army and the Instituto Antárctico Argentina.

I am grateful to Denise Landau, Tony Soper and Victoria Underwood for giving me the opportunities to gain insights into the expedition cruise industry in polar regions. I am further indebted to the officers, staff and crew of *Illiria*, *Alla Tarasova*, *Professor Molchanov*, *Professor Khromov* and *Caledonian Star* for their cooperation and support, and owe especial thanks to the officers, staff and crew of *Explorer* for awakening me to the full responsibilities of ensuring that tours to the Antarctic were safe, environmentally sound and educational. Their support and co-operation is much appreciated — both collectively and individually they have contributed greatly to this work and to ensuring the good reputation of the industry in Antarctica.

Thanks are due to the staff and students, past and present, of the Scott Polar Research Institute, who have been extremely helpful, cheery and fun to work with. I am greatly appreciative of my two long-suffering flatmates, Mark and Matthias, and to our two 'parasites', Andy and Taddy: I am well aware it is my turn to do the cooking, the dishes, get Sunday's croissants and papers, hang the washing out...

Finally, but most especially I would like to thank my family who have supported, encouraged, and entertained me, in every way, since this whole adventure began, in particular my father. It is to him that I dedicate this *magnum opus*.

Contents

List of Acronyms

ANI	Adventure Network International
ASMA	Antarctic Specially Managed Area
ASPA	Antarctic Specially Protected Area
ASTI	Area of Special Tourist Interest
ATCM	Antarctic Treaty Consultative Meeting
ATS	Antarctic Treaty System
BAS	British Antarctic Survey
CCAMLR	Convention on the Conservation of Antarctic Marine Living Resources
CEE	Comprehensive Environmental Evaluation
CEMP	CCAMLR Ecosystem Monitoring Programme
CEP	Committee for Environmental Protection
CNPPA	Commission on National Parks and Protected Areas
EIA	Environmental Impact Assessment
IAATO	International Association of Antarctic Tour Operators
IEE	Intitial Environmental Evaluation
IGY	International Geophysical Year
IUCN	International Union for the Conservation of Nature and Natural Resources / World Conservation Union
MARPOL	International Convention for the prevention of pollution from ships
NSF	National Science Foundation
OAC	Organisation of the American States
PAC	Project Antarctic Conservation
SCAR	Scientific Committee on Antarctic Research
SOLAS	Safety of Life at Sea
SPRI	Scott Polar Research Institute
SSSI	Site of Special Scientific Interest
UK FCO	United Kingdom Foreign and Commonwealth Office
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USAP	United States Antarctic Programme
USEPA	United States Environmental Protection Agency
WHC	Western Hemisphere Convention
WTO	World Tourist Organisation

These polar expeditions are becoming an industry.
Winston Churchill, 1913

Chapter 1
Introduction

1.1 Antarctic tourism

Tourism is the most recent large-scale human activity in the Antarctic region. The first modern commercial tourist visit was made in 1958 (Reich, 1980), since then, the mean annual number of tourists visiting the region has increased from fewer than 100 to nearly 10,000. Since 1989, when the accuracy of statistics improved, over 63,500 tourists have set foot on the Antarctic (NSF/IAATO, 1997), and a further 8,500 have viewed the continent during sight-seeing overflights (Headland, 1998).

While early human activities in the Antarctic were essentially exploitation of marine animals, exploration or science (Headland, 1989), tourism is based exclusively on the ambient resource. This involves a combination of remoteness, ice, clear waters, magnificent coastal and mountain scenery in a cold, extreme environment with opportunities to see a rich variety of wildlife at close quarters, all of which tourists regard as exciting and uplifting, providing them with a sense of adventure.

Antarctic tourism differs from conventional tourism in fundamental ways. First, facilities for tourists ashore are virtually absent: most tourists arrive and depart by ship, visiting 'wilderness' in which any infrastructure would be unwelcome. Second, it operates in an area governed, not by undisputed sovereign powers, but under an international treaty, the Antarctic Treaty (Appendix 1), the prime concern of which is to protect the continent for peace and scientific research. Third, it operates in the complete absence of any indigenous population. Fourth, it has no direct economic benefit to the

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Finally, by world standards Antarctic tourism is a small operation: many scenic villages in Britain attract more tourists annually than the whole Antarctic continent. However, tourist activities are concentrated in small areas of the continent that are also the areas of highest biological activity (Reich, 1980; Stonehouse, 1992a; see Section 3.4), generating concern that, even on a small scale, tourism cannot fail to affect Antarctic wildlife. Yet these concerns, compounded by a deep-rooted concept that polar ecosystems are 'fragile' or easily disturbed (see Section 2.3), have yielded surprisingly few comprehensive studies of tourist-generated disturbances in Antarctica.

Several short term studies have investigated visitor disturbance to particular species (for example, Culik *et al.*, 1990; Wilson *et al.*, 1991; Woehler *et al.*, 1994; Culik and Wilson, 1995; Giese, 1996; Fraser and Patterson, 1997; Nimon, 1997), usually in isolation, and often with contradictory results. The research reported here formed part of Project Antarctic Conservation (PAC), of the Polar Ecology and Management Group, Scott Polar Research Institute (SPRI), which has attempted a more comprehensive approach (see below).

Management policies for Antarctic tourism, evolving with insufficient research and information, have been mainly empirical. The environmentally-benign practices of Lars-Eric Lindblad, who started marketing regular summer cruising to Antarctica in 1966 and trained many of its early operators, established the industry on an environmentally responsible basis (see Section 3.3.2.1). This was reinforced by guidelines and codes of practice provided by subsequent expedition leaders (Naveen *et al.,* 1989, Splettstoesser and Folks, 1994). Antarctic Treaty principles under which the industry operated during its first three decades, were largely founded in recommendations and general guidelines, for example those of Antarctic Treaty

Recommendation VIII-9, Annex A(V) (Heap, 1994: 2297), and Recommendation XVIII-1 (Appendix 2), both of which are discussed below (see Section 2.5).

The 1991 Protocol on Environmental Protection to the Antarctic Treaty, which eventually came into force on January 14 1998, has introduced a stronger element of legal formality. For example, where earlier tourism activities were virtually unchecked, the Protocol (Appendix 3) requires that all activities in the Antarctic, including tourism, shall be

> *... planned on the basis of information sufficient to allow prior assessments of, and informed judgements about, their possible impacts... and that regular and effective monitoring shall take place to allow assessments of the impacts of ongoing activities.*
> (Article 3:2c&d; Heap, 1994:2019)

As national governments enact regulations to incorporate the terms of the Protocol into domestic legislation, Antarctic tour operators are submitting draft Initial Environmental Evaluations (IEE) to meet the requirements of the relevant governments (see Section 2.5.2). Since most Antarctic tourists operations are US-based, there is considerable interest in how that government is dealing with these responsibilities. However, programmes for *regular and effective monitoring* to allow assessment of tourist activities have yet to be elucidated and specific management objectives for these monitoring programmes yet to be defined (see Section 2.5.3).

1.2 Basis for the research: Project Antarctic Conservation (PAC)

This dissertation is founded on the author's five-year study of Antarctic tourism within PAC, based on research and experience at a field station and aboard tour ships. The study focuses on shipborne tourism, which accounts for 96.5% of all Antarctic tourists (Section 3.2.2). It concentrates particularly on issues relevant to landing sites that the ships visit in the Maritime Antarctic, which is the ecologically rich northern extension of Antarctica and its coastal islands (Section 1.4.1), where over 90% of all shipborne visits are made.

The International Union for the Conservation of Nature and Natural Resources (IUCN), in its report on Antarctic conservation (IUCN, 1991), recommended that controls over the growing Antarctic tourism industry be augmented by:

- a comprehensive review of tourism issues (including requirement of prior notification and approval of expeditions and tours, codes of conduct, safety standards, insurance, liability guidelines, environmental impact assessments, inspection and reporting procedures, information and educational materials);
- promoting interactions between governments, managers of national Antarctic programmes, scientists and tour operators with the intention of developing tour management guidelines;
- pro-active planning for ASTIs (Areas of Special Tourist Interest: see Section 2.5.1) followed by careful monitoring of subsequent impacts;
- controlling choice of tourist destinations.

The Polar Ecology and Management Group of Scott Polar Research Institute (SPRI), which prior to this study was already investigating Antarctic tourism, accepted these points as guidelines for a long-term study of the industry, its management, and its impacts on the Antarctic environment. Concentrating on shipborne tourism in the Antarctic Peninsula, the project leader defined the major objectives of the programme as:

- investigating how parties of tourists are managed, aboard ship and ashore;
- monitoring impacts of tourists on plant and animal communities and other facets of the environment;
- assessing impacts of tourists on all recorded landing sites;
- evolving and recommending management procedures that minimise undesirable impacts between tourists and the environment;
- finding effective ways of controlling tourism within the means, and consistent with the objectives, of the Protocol (Stonehouse, 1994a).

Fieldwork began in 1991–92 with surveys of tourist attitudes and impacts on Half Moon Island (a popular landing site in the South Shetland Islands: see Appendix 5 for co-ordinates of landing sites under discussion), cataloguing landing sites and other preliminary research (Stonehouse, 1992a). As Stonehouse (1992a) found the island unsuitable for longer-term studies, in the following summer PAC established a small research station on Cuverville Island, Danco Coast of Antarctic Peninsula. The author was deputy-leader during the first season, and leader during the following two seasons. The research detailed in Chapter 7, concerning tourist operations ashore, was undertaken at this station. Later the author spent part of her time in research aboard tour ships (see below).

In January and February 1994 a second station was opened for five weeks on Hannah Point where, for comparative purposes, five researchers undertook mapping, ecological inventories and visitor surveys similar to those done on Cuverville Island.

Since it began in 1989 PAC has involved over 30 participants, from senior scientists to assistants, of whom 12 worked in various studies on Cuverville Island. Results of PAC studies have already appeared in M.Phil. (Waugh, 1994; Minbashian, 1996) and PhD theses (Enzenbacher, 1995; Harris, 1993; Dey, 1995; Davis, 1995a; Nimon, 1996), research papers and reviews (for example, Acero and Aguirre, 1994; Enzenbacher, 1993a, 1995; Davis, 1995b; Nimon *et al.*, 1995, 1996; Stonehouse and Crosbie, 1995) and more are available in unpublished reports (for example: De Leeuw, 1994; Weinstein, 1994).

1.3 Field studies

Field studies were undertaken at Cuverville Island and on cruise ships in Antarctic and Arctic waters.

Cuverville Island was chosen as the site for the PAC research station because it was becoming a popular location for tourist visits, and its history as a landing site was known; there were no reports of visits earlier than 1984 (Splettstoesser, *pers. com.*). The three-year research programme (1992–95) was designed to collect data that would provide (a) a baseline for future monitoring at this site and (b) recommendations for the formulation of management policies (Stonehouse, 1992a).

In the first season (1992/93) a team of eight completed an inventory of all animal populations and botanical sites, began behaviour studies of gentoo penguins, monitored the behaviour and attitudes of over 1,500 tourists, and made ecological assessments of nearby landing sites on Rongé Island and in Errera Channel (Stonehouse, 1993). In addition, the author also completed a topographical survey at scales of 1:5000 for the island and 1:1000 for the main study area in 1992/93 (see Maps 7.1 to 7.4) . Similar studies continued during the 1993/94 summer, with a team of five testing methods and hypotheses arising from the earlier work. During the 1994/95 season, in addition to supervising a team of three in the continuing research, the author developed studies on the spatial diffusion of visitors at the landing site (Section 7.3), responses of flying bird species to human approaches (Section 7.5) and penguin/skua interactions in the presence and absence of visitors (Section 7.6). The station closed, and was removed, in late February 1995.

From observing the various ways in which tour parties were managed ashore, and through discussions with shipborne staff and tourists, the author perceived that in two very important issues relating to site management, deciding which sites would be visited and managing visitors ashore, the most important role was that of the expedition leader. By understanding this role, more effective and practical management techniques could be proposed.

In 1993, as part of her research programme, the author started working in expedition cruising, taking employment with four different companies on several vessels to a variety of destinations, including some Arctic ones. She became expedition leader on Antarctic cruises in 1995/96 and 1996/97, an experience that provided valuable insights into cruise operations, how operators work, and how the industry is attempting to meet obligations imposed by the Protocol. This complemented the work completed on Cuverville Island. This experience is incorporated in several parts of the thesis, in particular Chapters 4 and 6.

1.4 Concepts and definitions

The following concepts, discussions and definitions are pertinent to this study.

1.4.1 Maritime Antarctic

On the basis of climate Holdgate (1964:183) subdivides the Antarctic into two major areas (Map 1.1). The Maritime Antarctic (Map 1.2) includes the Antarctic Peninsula, South Shetland Islands and South Orkney Islands. The Continental Antarctic includes the rest of the continent. The Maritime Antarctic, unsurprisingly, has the characteristic maritime climate, generally warmer and wetter than continental climates. Mean monthly air temperatures rise above freezing for at least one month in summer, and rarely fall below –10°C in winter. In the Continental Antarctic mean monthly air temperatures rarely exceed freezing point in summer and fall well below –20°C during winter to a world record low of -89.7°C at Vostok Station (Map 1.1). Further characteristics of both climates are reviewed in Stonehouse (1989: 52–55),

Inevitably, these temperatures influence the ecology of the regions. The Maritime Antarctic sustains colonies of virtually all the breeding bird species found in the Antarctic, a flora of mosses, liverworts, lichens and two species of flowering plants, as well as a variety of substrate organisms (insects and mites). The Continental Antarctic, colder and drier, supports many lichen species, only a few moss species but neither liverworts nor flowering plants, and there are fewer breeding bird species. Although Holdgate (1964) does not define a southerly limit to the Maritime Antarctic, Stonehouse (1989: 55) sets it at approximately 64°S on the Weddell Sea coast of the Antarctic Peninsula, and 69°S on the warmer west coast.

The Maritime Antarctic is the most accessible area of Antarctica, being only 770 km from South America. Its waters are regularly ice-free for several months during the summer. In consequence, this is the area that has, and is likely to continue to have, most human activity to date. Sealing and whaling occurred in this region in the 19th and early 20th Centuries and, since the 1950s, it has had the highest density of scientific stations in the Antarctic. Although sovereignty claims are in abeyance under the Antarctic Treaty, this region is also covered by the overlapping territorial claims of Britain, Argentina, and Chile (Headland, 1989).

1.4.2 Defining management

To manage is *...to organise, regulate or be in charge of* (Oxford English Dictionary), management, by extension, is the process by which this is enacted. Inevitably, management strategies will have objectives which will guide the decision-making processes and practices. Successful and cohesive 'management' of any resource, including the 'environment' or 'wilderness', requires clear objectives (Hendee *et al.*, 1990a).

1.4.2.1 Management and monitoring objectives

Article 3, section 1 'the Environmental Principles' of the Protocol states: *The protection of the Antarctic environment and dependent and associated ecosystems and the intrinsic value of Antarctica, including wilderness and aesthetic values and its value as an area for the conduct of scientific research, in particular research essential to understanding the global environment, shall be fundamental considerations in the planning and conduct of all activities in the Antarctic Treaty area* (Heap, 1994:2019). This basic principle is the foundation for any Antarctic environmental management assessment. Within it there are three criteria:

- protection of the environment, dependent and associated ecosystems;
- the intrinsic value of Antarctica, including wilderness and aesthetic values; and
- Antarctica's value as an area for the conduct of science.

The term *wilderness and aesthetic values*, left deliberately vague in the interests of reaching accord between many different nations and cultures (Heap, *pers. com.*), is, in practical terms open to different interpretations, and hence, raises problems for management practices. For example, Davis, a member of the PAC team from 1992 to 1994, represents the view that the danger from tourism in Antarctica is not that visitors may intentionally harm the wildlife or disrupt the environment but that, little by little, marketing forces will initiate many activities not in keeping with the value of the Antarctic wilderness (Davis, 1995a:4; see also Section 2.2.3).

Developing management objectives to deal with such an issue may result in conflict among the many sovereign states and cultures involved in the Antarctic, each bringing a different concept of the value of wilderness (see Section 2.2.4), however, some attempt must be made to give meaning to the terms. A study at present under way (Codling, *pers.com.*) is attempting to provide such a definition.

A more immediate need is for management criteria which satisfy the two other requirements listed: the protection of the Antarctic environment, and protecting its value for science. Although scientific studies can be made of any environment, whatever the state, these two requirements are inextricably linked; the Antarctic's value to science stems largely from its virtually undisturbed state (Benninghoff and Bonner, 1985), thus any action that avoids degradation of the environment protects it for all human purposes, including science.

Therefore, while there are circumstances in which the value of the environment to science may be enhanced by disturbance, enabling research to measure the consequences (e.g. Penhale *et al.*, 1997) and thus determine fundamental processes, for the purposes of this dissertation, protection of the Antarctic environment in an undisturbed state is taken as a pre-requisite in protecting the Antarctic for science.

1.4.3 Managing for integrity

Minbashian (1997:18), another member of the PAC team, argues that simply ... *minimising impact on Antarctic environments* is insufficient as a management goal as it fails to take into account the ... *desired characteristics or desired state of a system. Merely minimising impact, emphasises what we do not want, but offers no guidelines for positive action*. She offers instead the concept of biological integrity as a major objective in environmental management.

This concept is increasingly popular in environmental management (Noss, 1995). The word integrity, rooted in the Latin word *integritas* , translates as ... *whole, a thing complete in itself.* Aldo Leopold wrote *a thing is right when it tends to preserve the integrity ... of the biotic community* (Leopold, 1949:224-225), and biological integrity has been defined as ... *the ability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organisation comparable to that of the natural habitat of the region* (Karr and Dudley, 1981: 56).

In an Antarctic context, Minbashian (1997:23) defines biological integrity as a useful goal for monitoring human disturbance on the biota, because it includes both the composition of species and their functional characteristics, as well as allowing for natural fluctuation.

However, biology is the study of living organisms and systems, while ecology is the study of the interrelationships between living organisms and their environment. To encompass implications of disturbance on any component of the environment arising from tourist activities, *ecological integrity* is arguably a more practical concept, offering the benefits listed by Minbashian, but also including alterations to, and natural changes in, the physical environment.

Adapting Karr and Dudley's (1981) definition, ecological integrity may be defined as *the ability to support and maintain a balanced, integrated, adaptive ecosystem which supports a species composition, diversity and ecological organisation comparable to that of the natural habitat of the region* . This implies that physical as well as biological implications of disturbance are included, for example, hydrological patterns changing as a result of footpath erosion. It is applicable to regions and equally to specific sites within regions, given that the range of tolerance of a species is not constant throughout its geographical range, but varies from locality to locality according to variations in environmental factors: the concept of ecological valency (Lincoln *et al.,* 1982; Kuss *et al.,* 1990).

In this study an important objective is maintaining the ecological integrity of the Antarctic landing sites. This requires identifying and describing of variables which compose a region or site, monitoring interactions between these and visitors and, thereby, determining strategies which maintain the natural system. Finally, it requires subsequently monitoring to assess the strategies' operation, be it successful or otherwise, and suggest means of improving the strategy where appropriate.

1.4.4 Impacts

In the context of this study impacts are defined as human-induced disruptions of processes and functions needed to maintain ecological integrity of a site. The Protocol defines two forms of impact (minor or transitory) at three levels (less than, equal to, or greater than: see also Section 2.5.2). Where possible, impacts will be described and categorised on the basis of these definitions.

1.5 Aims and scope of the dissertation

The aim of the dissertation is to examine tourist use of landing sites in the Maritime Antarctic. Major objectives of the underlying research were:

- To review the current status of shipborne tourism in the Maritime Antarctic, and compare its potential for disturbance with those of other forms of Antarctic tourism;

- to review the structure of the Antarctic shipborne tourism industry, the role of the International Association of Antarctica Tour Operators, and the responses of the industry to recently imposed requirements of the Antarctic Treaty System;
- to identify, from information published by the US National Science Foundation, all landing sites currently used in the Maritime Antarctic, to group them geographically, and analyse yearly and seasonal trends in their use;
- to review operations at the landing sites, including site selection, preparation and variation of itineraries;
- to study in detail tourist interactions with the environment at one popular site (Cuverville Island), to establish what needs to be known to assess disturbance on particular species at this site;
- to recommend methods of monitoring as a contribution toward the more effective management of landing sites.

1.6 The structure of the dissertation

Chapter 2 introduces Antarctic tourism as an aspect of nature tourism, discussing it in the context of sustainable development. The chapter reviews concepts and definitions of wilderness considering the legal definitions required, before examining Antarctic tourism management in the political context in which this takes place, that of the Antarctic Treaty. It details the basis of the concerns about Antarctic tourism, and focuses on the principles and requirements which Antarctic tour operators must comply with under the Protocol. The Protocol requires, at minimum, a preliminary environmental assessment for any human activity in the Antarctic, whatever the scale of operation. As requirements under the Protocol are primarily activity-based, it describes how Antarctic tour operators are relatively unrestrained in their access to the continent, the only limit being that they cannot visit designated sites, which have been protected for scientific purposes, or research stations, without prior permission. The chapter concludes that for Antarctic tourism, given the large proportion of US-operators and

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1.6 The structure of the dissertation

Chapter 2 introduces Antarctic tourism as an aspect of nature tourism, discussing it in the context of sustainable development. The chapter reviews concepts and definitions of wilderness considering the legal definitions required, before examining Antarctic tourism management in the political context in which this takes place, that of the Antarctic Treaty. It details the basis of the concerns about Antarctic tourism, and focuses on the principles and requirements which Antarctic tour operators must comply with under the Protocol. The Protocol requires, at minimum, a preliminary environmental assessment for any human activity in the Antarctic, whatever the scale of operation. As requirements under the Protocol are primarily activity-based, it describes how Antarctic tour operators are relatively unrestrained in their access to the continent, the only limit being that they cannot visit designated sites, which have been protected for scientific purposes, or research stations, without prior permission. The chapter concludes that for Antarctic tourism, given the large proportion of US-operators and tourists, US legislation is most likely to affect their operations. The US-Interim Final Rule, the present basis for legislation specifies procedures for assessment and verification of impacts that appear to be inadequate and not in keeping with the principles of the Protocol, but, as yet, remain to be tested.

Chapter 3 reviews the development of Antarctic tourism over the last forty years, distinguishing four distinct categories — overflights, flights with landings, yacht cruises and shipborne tourism. It compares the effects of these four kinds of tourism, by the environmental context in which they take place and concludes that shipborne tourism has the greatest potential for disturbing Antarctic ecosystems.

Chapter 4 reviews the organisation of Antarctic shipborne tourism, discussing the relationships between companies and their trade organisation, the International Association of Antarctica Tour Operators (IAATO). As IAATO members are committed to consenting with Treaty measures, complying with Protocol requirements was begun by meeting to establish an outline for an Initial Environmental Evaluation (IEE) for all shipborne tourism operations in the Antarctic Peninsula region. The chapter discusses matrices prepared at this meeting, for ship, landing craft (Zodiac) and shore operations, which identified and characterised actual and potential impacts. Through the matrices it became evident that disturbances from ship and Zodiac operations were relatively easy to identify and mitigate. However for shore operations, in which tourists have direct contact with the biota, impacts were less tangible, more difficult to mitigate, and most likely to inflict significant damage through repeated slight perturbations. Thus, this chapter concludes that landing operations and sites required more detailed investigation.

Chapter 5 examines landing site use, based on data collected by the National Science Foundation (NSF) and IAATO for each season since 1989/90. It reviews five variables: the numbers of passengers, ships, voyages, sites used and landings made. The five variables are presented graphically and discussed in the context of experiences within the industry. Landing sites are shown to be clustered in five identifiable geographic areas within the Maritime Antarctic. These five sub-regions can be differentiated both in actual characteristics and in amount of use. Through analysis of use it is evident that, despite the increase in number of passengers, there have been fewer passengers per voyage, but more voyages for each vessel, primarily through the use of smaller vessels undertaking shorter voyages. Furthermore, it shows that the number of sites used and landings made each year varied according to the number of voyages, rather than the number of passengers. It appears therefore that tour operators require a certain number of sites to be visited during each voyage for passengers to experience a range of characteristic features.

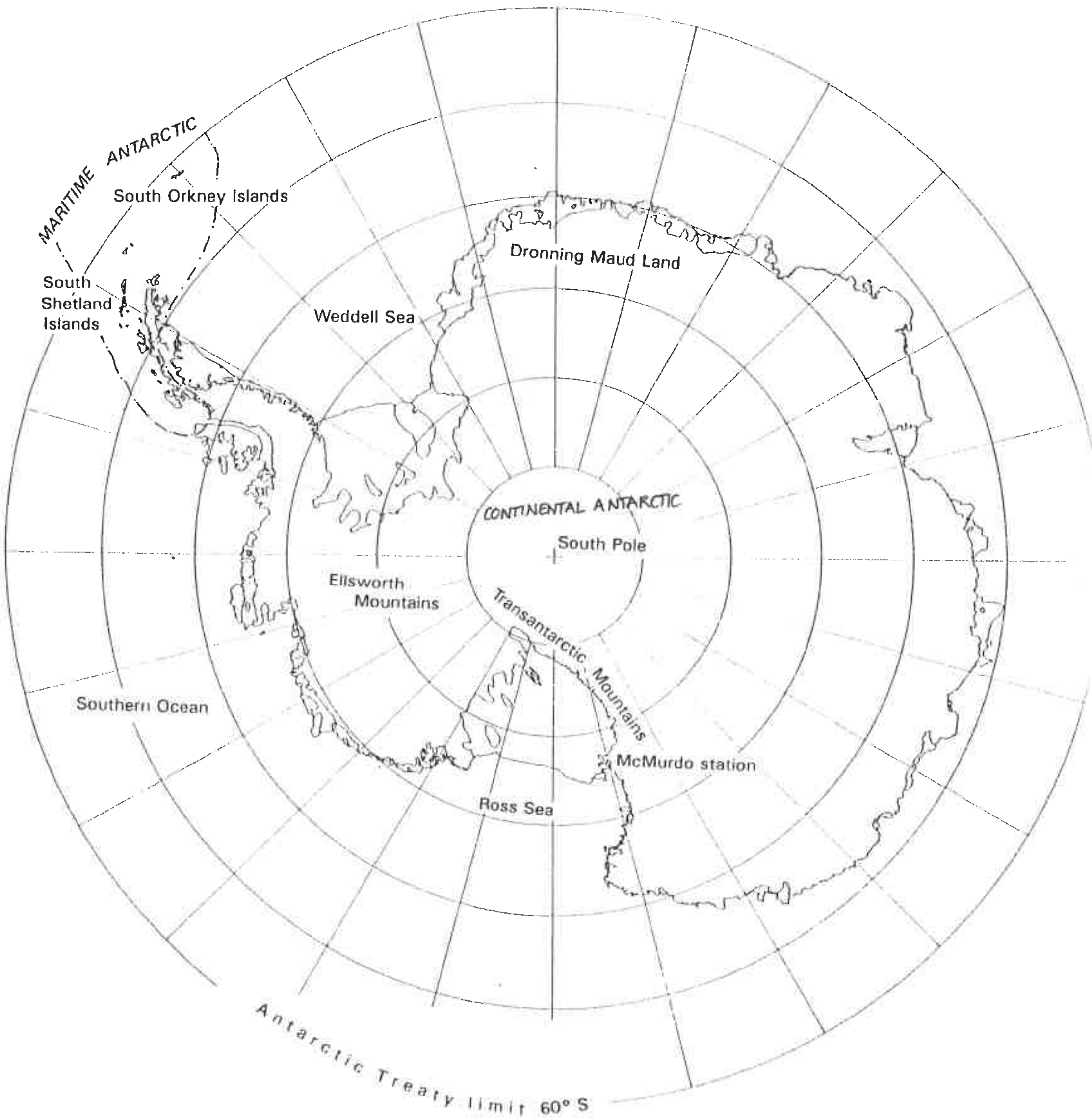
Chapter 6 investigates landing organisation and site selection procedures. As landing sites have neither general nor specific management plans, tour operators, and particularly expedition leaders, adopt strategies based on their experience. Responsibility for management of tourists at sites has therefore devolved on a few individuals. This chapter concludes that landing operations are generally competent and safe, but the decision-making processes behind the site selection criteria acknowledges that not all sites are the same, some need greater care and sensitivity than others.

Chapter 7 reports on a detailed three-season study of a popular landing site, Cuverville Island, about which little was known prior to 1992. This study assessed both visitor use of the site by monitoring their distribution over the site, and the immediate responses of specific species to tourist disturbance. It was established that the areas that were consistently subject to the highest amount of visitor activity were those of interest nearest the Zodiac landing point and that smaller groups tended to disperse further over the site than larger groups. In general, however, it was found that only a very small area of the site was actually used regularly by visitors. As sensitivity to disturbance appeared to vary between species, it was possible not only to make management recommendations for visitors to Cuverville Island, but also to identify indicator species which can be used for monitoring at other sites.

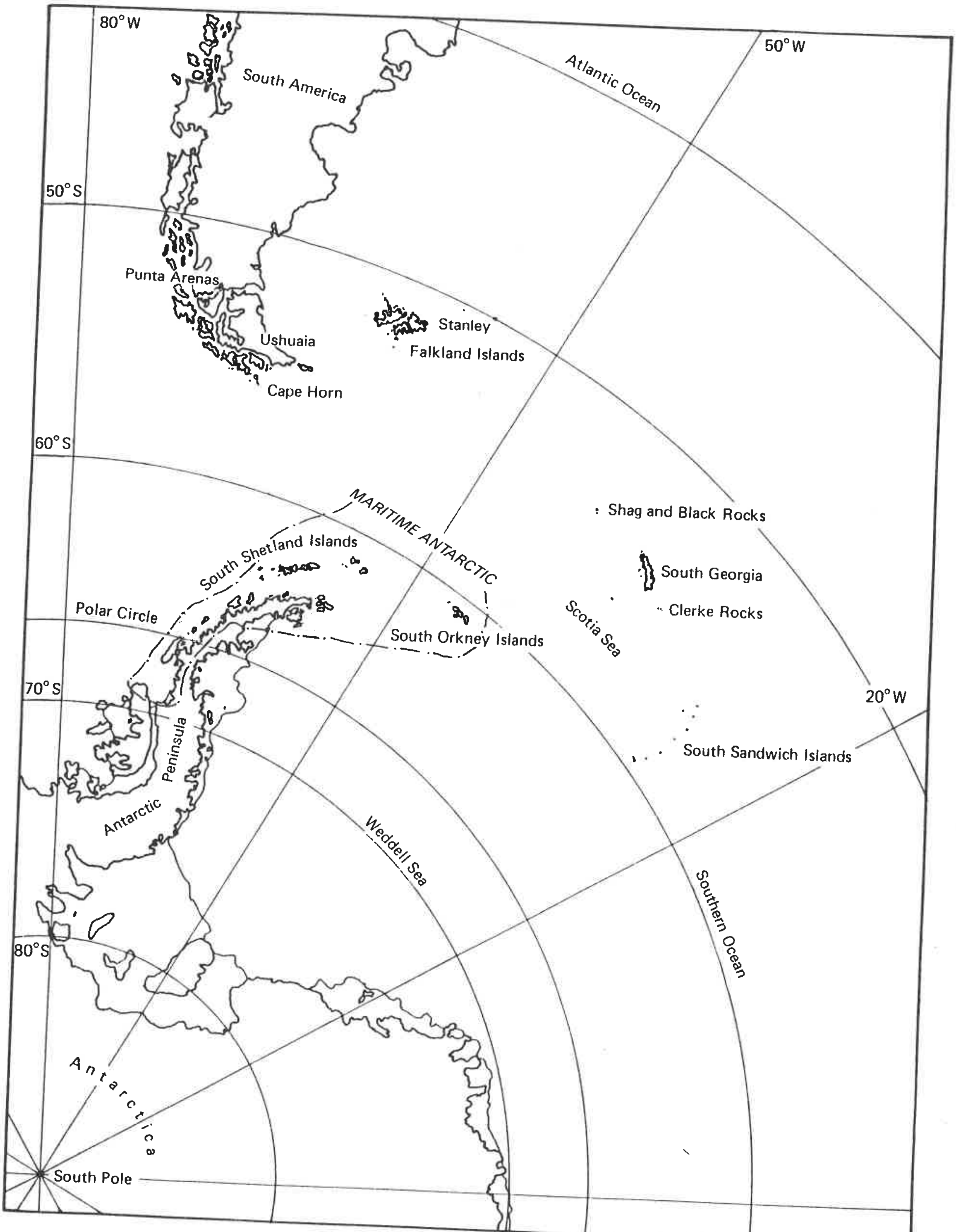
Finally, in Chapter 8, this dissertation proposes guidelines for a monitoring and management programme to assess cumulative impacts at landing sites. As, in the present political circumstances, the industry is a major factor in site management, the monitoring programme emphasises the importance of co-operation and collaboration with tour operators, in addition to scientific research. Equally, since the expense of such a monitoring programme would be difficult to justify on the basis of tourism monitoring alone, it is recommended that the monitoring programme should be compatible, and integrated with other Antarctic monitoring programmes, in particular that of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Ecological Monitoring Programme (CEMP).

Chapter 9 presents a summary of conclusions emphasising that, as the level of tourist activity increases in the Maritime Antarctic, there is a definite need for a more formalised approach to the management and use of tourist landing sites.

Map 1.1 Continental and Maritime Antarctic regions (after Holdgate, 1964).



Map 1.2 The Maritime Antarctic.



Chapter 2

Antarctic tourism and environmental management

2.1 Introduction

This chapter introduces Antarctic tourism as an aspect of nature tourism, the rapidly-expanding branch of the tourist industry that provides access to nature and wilderness. It examines the concept of ecotourism, the aspiration of the industry to high levels of environmental care and sustainability, and explores both the concept of sustainability and the management criteria required for sustainable tourism. It discusses the concept of wilderness, a term often applied to Antarctica and reviews some of the legal definitions of wilderness required for management.

The threats from Antarctic tourism that are perceived by environmentalists and those others who use the region are considered, particularly the validity of threats to scientific research and to the environment. The consequences of earlier use, especially by sealers, whalers, explorers and scientists are reviewed, noting that some of the industrial effects may still be apparent long after the industries have disappeared from the area.

Finally this chapter outlines the principles under which Antarctica is currently governed, and by which the tourist industry is bound — the environmental regulations imposed by the Treaty and Protocol, the requirements to submit 'environmental impact assessments', and ways in which the new regulations affecting tourism are being implemented.

2.2 Antarctic tourism: seeking the wilderness

> *Man inhabits two worlds. One is the natural world of plants and animals, of soils and airs and waters which preceded him by billions of years and of which he is a part. The other is the world of social institutions and artefacts he builds for himself, using his tools and engines, his science and his dreams to fashion an environment obedient to human purpose and direction.*
>
> (Ward and Dubos, 1972, cited in Holdgate, 1979: 1)

Ward, an economist, and Dubos, an environmentalist, describe an essential paradox in human society — the dichotomy between the natural world and the environment that man creates for his own comfort and well-being. As we become increasingly enmeshed in the social, civilised world, leisure visits to remote wilderness areas, perhaps searching for glimpses of the 'natural' world of plants and animals, have become increasingly attractive.

The attractions of atavistic journeys to wilderness are a relatively new phenomenon. *Tour,* in the sense of an ordered journey, was first used in 1643 (Oxford English Dictionary). Later the term came to describe a journey for recreation or pleasure: the 'grand tour' of Europe, first used in 1748, was primarily a cultural circuit of cities and places, a taste of former and higher civilisations for young aristocracy, ... *supposed to be necessary to complete the education of young men of position* (Concise Oxford Dictionary).

Romantic interest in wilderness areas came later, developing during the 18th and early 19th centuries. Embodied in the writings of John Muir and Henry David Thoreau in North America, Victor Hugo in France and Sir Walter Scott in Britain (Mather, 1986), it widened the focus of interests within tours, from relics of ancient civilisations to wonders of the natural world. Prosperous recreational travellers began to include in their itineraries magnificent scenery, wildlife, and a general appreciation of nature. First in the United States, later in Europe and elsewhere, this broadening of interest stimulated public awareness of the value of wilderness, which was by then rapidly disappearing, and fostered the development of public facilities combining recreation and conservation, typified by national parks.

The spread of prosperity in the western world during the mid-to-late 20th century, and the development of cheap, rapid transport, gave increasing numbers of people opportunities to travel, and to experience wild nature at first hand. Interest in geography, biology and ecology, stimulated by growth of scientific knowledge and its popular dissemination (for example, by the National Geographic Society and BBC Natural History Unit), resulted in a vast increase in nature tourism (Hall and Johnston, 1995). Today almost every undeveloped area of the globe, including the most isolated and remote, has come within reach of the recreational traveller, even excursions beyond the atmosphere are becoming practicable (Zegrahm, 1997).

Even Antarctica, which not long ago provided the epitome of remoteness and difficulty of access, was visited in 1997/98 by almost 9,500 tourists, seeking their opportunity to experience the 'natural world' described by Ward and Dubos. This is a small number in comparison with the mass-tourism experienced in many other parts of the world. However, Hall's (1992:4) definition of Antarctic and sub-Antarctic tourism as *...all existing human activities other than those directly involved in scientific research and normal operations of government bases...* indicates the relative absence of other forms of human activities in this remote region, and the growing importance of tourism in relation to more traditional uses.

2.2.1 Tourism and ecotourism

The terms *tourist* and *tourism* , implying organised travel for curiosity and pleasure, were first used around 1800 (OED). The Shorter Oxford English Dictionary defines a tourist as one who ... *travels for pleasure or culture, visiting a number of places for their objects of interest, scenery or the like* , and tourism as ... *the theory and practice of touring; travelling for pleasure* . Typically, modern tourists are clients of a huge and rapidly growing world industry, a major economic force which currently employs 112 million people, caters annually for over 500 million travellers, and accounts for 70% of all air travel (Ceballos-Lascuráin, 1996).

International tourism maintains the inter-governmental World Tourism Organisation (WTO), recognised as an Executive Agency of the United Nations Development Programme (UNDP). WTO subscribes to the concept of *sustainable tourism development* (see below) and, through its Environment Committee, pursues an image of environmental responsibility. In 1982 the Committee, in co-operation with the United Nations Environment Programme (UNEP), produced a *Joint declaration on tourism and environment* . More recently, it joined with UNEP and the International Union for the Conservation of Nature and Natural Resources (IUCN) to produce *Guidelines: development of national parks and protected areas for tourism* (McNeely *et al.*, 1992).

Of the wide range of activities and interests for which the industry caters, the term *nature tourism* has been used to describe ... *all forms of tourism that are directly dependent on the use of natural resources in a relatively undeveloped state, including scenery, topography, water features, vegetation and wildlife* (Ceballos-Lascuráin, 1996). Currently the most rapidly growing sector of the tourism market, it includes hunting, cross-country motor-biking and other activities, sometimes when these uses of the natural resources by the tourist are ... *neither wise nor sustainable* (Ceballos-Lascuráin, 1996.) *Sustainable tourism* , as discussed in Ceballos-Lascuráin (1996.), distinguishes ... *forms of tourism developed and managed in ways that allow them to continue indefinitely*. Sustainable tourism does not detract from efforts to maintain the resources on which it is based in perpetuity.

From this concept has arisen the refinement of *ecological tourism*, or *ecotourism* , defined by Ceballos-Lascuráin (1993) as:

> ... *environmentally responsible travel and visitation to relatively undisturbed natural areas, in order to enjoy and appreciate nature (and any accompanying cultural features — both past and present) that promotes conservation, has low visitor impact, and provides for beneficially active socio-economic involvement of local populations.*

(cited in Ceballos-Lascuráin, 1996:20)

Since its advent the term *ecotourism* has been seized on by tour operators, and, in many instances, devalued by use in advertising, to emphasise the environmentally-benign qualities of their tours. When used precisely it remains a valid concept, implying a kind of tourism in which activities are restricted to enjoyment and appreciation, with conscious efforts made to reduce impacts and disturbance, and to achieve both economic and ecological sustainability.

Hall and Johnston (1995), in a volume devoted to polar tourism, use the term in this sense when observing that wilderness areas, national parks and reserves, and other lands remaining in a relatively undisturbed state are prime attractions for travellers seeking *green* , *adventure* , *eco-* or *alternative* tourism experiences. Cater and Lowman (1994) edited a symposium volume on *Ecotourism — a sustainable option?*, in which Stonehouse (1994a) discusses the sustainability of ecotourism in Antarctica, while Hall and Wouters (1994) considered the issues related to sustainable tourism in the Sub-Antarctic.

Because of its devaluation by dubious advertising, few major Arctic or Antarctic tour operators currently use the term *ecotourism* in their brochures, and *sustainable tourism* has failed to achieve a similar popular appeal. However, the more responsible tour operators are aware that environmental concern is an aspect on which they are judged, both by clients and by the authorities which control their activities, and take pains to make clear that they conduct their tours in environmentally benign and sustainable ways.

2.2.2 Sustainable tourism

> *Tourism in polar regions requires a high quality environment since it is the landscape itself that serves as a major drawcard for tourist activities whether they be educationally, culturally or adventure oriented ... If the image and reality do not match for the tourist because of obvious environmental damage, the experience itself can be negatively affected, as can the industry.*
>
> Johnston and Hall (1995: 300-301)

This argument of Johnston and Hall (1995) suggests that a basic objective of the tourism industry in polar regions must be sustainability, that is to ensure that the environment in which it operates is affected as little as possible by the industry's own activities.

The concept of sustainable development came to prominence following publication of the IUCN *World conservation strategy* (IUCN, 1980) and *Our Common Future* (World Commission on Environment and Development, 1987). These documents deem a development to be sustainable if it uses resources in ways that meet the needs of the current human population without compromising the needs of future generations. Problems inherent in the sustainable development of tourism have been discussed for example by Boo (1990), Butler (1991), Cater (1994), McCool (1994), Prosser (1994), Coccossis and Nijkamp (1995), Hunter and Green (1995), and Ceballos-Lascuráin (1996). While much of this literature relates to mass tourism, and the impacts of tourism on sociological elements such as indigenous cultures, impacts on nature more relevant to Antarctic tourism have been addressed by Boo (1990), Cater (1994) and McCool (1994) among others.

Table 2.1 Examples of environmental impacts of tourism in protected natural areas (after Boo, 1990; Ceballos-Lascuráin, 1996).

Location	Factor involved	Impact on environment	Consequence
Maasai Mara (Kenya)	Overcrowding	Environmental stress, behavioural changes in animals	Reduction in quality of wilderness experience, and animal encounters
Poas (Costa Rica)	Noise	Disturbance of natural sounds	Irritation to wildlife and visitors
Rio Dulce (Guatemala)	Powerboats	Disturbance of bird life, noise pollution	Vulnerability during nesting season
Mt. Everest (Nepal)	Litter	Impairment of natural scenery	Lessening of aesthetic qualities and health hazard
Galapagos (Ecuador)	Feeding of animals	Behavioural changes in animals	Possibility of dependence on steady food supply
Bahía (Brazil)	Souvenir collection	Removal of natural artefacts, disruption of natural processes	Degradation of protected areas
Bojorquez Lagoon, Poas (Costa Rica)	Untreated sewage discharge	Change in water acidity, ground water pollution	Eutrophication, odour
Cairngorms (Scotland)	Creation of trails and tracks	Habitat loss, scarring of vegetation	Lessening of aesthetic qualities; changes in vegetation patterns

That tourism in tropical and temperate wilderness is not always conducted in sustainable ways is clear from Table 2.1. Many of these examples involve large-scale tourism to sites subjected to repeated visits over many years. In the Arctic, Viken (1995, 1996), Stonehouse *et al.* (1995) and Stonehouse (1996), observing tourism in Svalbard, presented evidence of littering and gross disturbance to breeding bird colonies and historic sites, making it unsustainable, despite protective legislation and the presence of rangers and police. Butler (1994) illustrated that, despite the general acceptance of the desirability of sustainable development, there were problems achieving this in the Canadian Arctic because of the diverse interests involved.

What of Antarctica, where the resources exploited by the tourist industry are wilderness, historic sites, wildlife and scenery, all of which are easily disturbed, including natural ecosystems that some regard as more than usually fragile? Is Antarctic tourism operating sustainably? While many credit the Antarctic tourism industry with, to date, a responsible approach to this unique environment (e.g. Beck, 1994; Bauer, 1994; Enzenbacher, 1995), Stonehouse (1994a) and Smith (1994) emphasise the surprising lack of information on the industry's environmental impacts, during its period of growth and expansion as well as at present.

Applying McKercher's model (1993) for sustainable development to polar tourism, Stonehouse *et al.* (1995) and Stonehouse (1996) concluded that, before predictions on sustainability can be made, long-term field studies of the effects of the industry are needed in both polar regions.

2.2.3 The concept of wilderness

Antarctica is frequently described as *wilderness* in both formal and informal documents. IUCN (1991), in its *Strategy for Antarctic Conservation* , writesof ... *the grandeur and solitude of the Antarctic wilderness*, and almost every brochure for Antarctic tourism stresses the wilderness that its tours make available to clients. The term *wilderness* has many definitions, both in general parlance and, more specifically, within ecology (Hendee *et al.*, 1990b, see Section 2.2.4). Basically it means *wild or uncultivated land* (OED), i.e. land that has not been altered by human efforts. However, ecologists who seek to manage wilderness, either to maintain it in pristine state or to make it available for recreational use, face two problems.

First, if wilderness is defined as land that is free from human influences, then *managed wilderness* and *wilderness management* become self-contradictory. This is undoubtedly true: wilderness itself requires no management, and none is needed so long as the wilderness remains free from human influences. However, with the expansion of human populations into previously unpopulated areas of the world, for settlement, exploration, warfare, scientific research and many other purposes including tourism, it becomes arguable that every wilderness area has already been penetrated by man, and — more significantly for the future — none remains free from the *threat* of human incursion. Thus there has arisen a body of management practices specifically for dealing with wilderness, including pre-emptive management for application when the threat of human incursion becomes reality (e.g. Hendee *et al.*, 1990a).

Second, 'wilderness' covers a wide range of concepts that depend on the cultural experience and development needs of those involved. In the Judeo-Christian tradition, wilderness was accursed land, where exiles experienced isolation, fear and penitence. North American plains, that were hostile wilderness to immigrant Europeans with this tradition, were benevolent, sustaining environments to native peoples (Hendee *et al.*, 1990b). Only in the last 150 years or so has wilderness become a source of inspiration and recreation within cultures non-indigenous to it (Mather, 1986).

Different interpretations and concepts of wilderness remain of philosophical interest until the practical question arises: how are tracts of land that are identified as wilderness to be maintained against incursions of an ever-increasing human population? What objectives are appropriate for wilderness management; how are they to be achieved, and how will it be determined if these strategies are successful? At this point the term 'wilderness' ceases to be applicable in a vague way to any area that is free from signs of human intervention, and 'legal wilderness' starts to demand definition within ecology (Hendee *et al.*, 1990b, see Section 2.2.4). Basically it means *wild or uncultivated land* (OED), i.e. land that has not been altered by human efforts. However, ecologists who seek to manage wilderness, either to maintain it in pristine state or to make it available for recreational use, face two problems.

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2.2.4 Legal definitions of wilderness

Of the major international conventions that seek to protect nature and wildlife, the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere (the 'Western Hemisphere Convention', or WHC), which became effective in April 1942, was among the first to emphasise the need to conserve habitats as a means of protecting species, mainly concentrating on the establishment of parks and reserves (Lyster, 1985).

Like many similar international conventions on environmental well-being, it had (and still has) no permanent secretariat capable of bringing conservation issues continuously and persuasively before relevant governments. However, WHC has in many ways provided a model for later international conventions on the protection of terrestrial habitats (Lyster, 1985). Its concepts and definitions are accepted widely by members of the Organisation of American States (OAS), including many — for example, Argentina, Chile and USA — with strong interests and responsibilities in Antarctica.

WHC defined national parks and reserves and nature monuments in Articles 1(1–3), and in Article 1(4) defined 'wilderness' in terms of 'strict wilderness reserves'. These are regions:

> *... under public control characterised by primitive conditions of flora and fauna, transportation and habitation wherein there is no provision for the passage of motorised transportation and all commercial developments are excluded.*

The proviso *... under public control* was clearly required for a wilderness area that was intended to be maintained as a reserve (Lyster, 1985:100).

The US Wilderness Act of 1964, in which the government sought to define its responsibilities under the WHC, established a National Wilderness Preservation System for the USA, defining 'wilderness' (Section 2c) in terms that are often quoted:

A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognised as an area where the earth and its community of life are untrammelled by man, where man is himself a visitor who does not remain...

The Act further described wilderness as ... *land retaining its primeval character and influence, without permanent improvements of human habitation* , specifically ... *protected and managed so as to preserve its natural conditions* . In addition wilderness:

(1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
(2) provides outstanding opportunities for solitude or primitive and unconfined types of recreation;
(3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and
(4) may also contain ecological, geological or other features of scientific, educational, scenic, or historical value.

However, as in WHC, the 1964 Act required wilderness so defined to be under public control, in this case US government control, presumably so that measures required to maintain wilderness areas could be legally enforced. The Act did not recognise wilderness areas that were not public property.

Internationally IUCN, through its Commission on National Parks and Protected Areas, has sought to define 'wilderness' in successive editions of its terminology of classification categories for conservation management. After some difficulty and ambivalence in earlier lists, its current listing (IUCN, 1992) includes wilderness under Category 1b (Wilderness Area; protected area managed mainly for wilderness protection). A wilderness area is defined as:

Large area of modified or slightly modified land, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.

By the ecological criteria included in any of these definitions, Antarctica as a whole falls into the category of wilderness. Exceptions occur in very small areas where past or contemporary human activities are apparent, for example abandoned whaling stations and stores dumps, current scientific stations (some of which have reached the size of small towns), and disused stations. Although these are in places intrusive, tourists who visit the Antarctic in search of the advertised concept of wilderness usually find enough relatively untouched ground to avoid disappointment. Many have particular interests in modern stations and historic sites.

Is Antarctica legally wilderness? With the suspension of sovereignty, and because of the requirement for public ownership, Antarctica cannot be wilderness in the sense that areas of the USA are wilderness under the US Act of 1964. While claimant countries are individually free so to designate areas within the boundaries of their claims, in this context the Treaty Consultative Parties do not offer themselves as a substitute for sovereignty. Under the Agreed Measures of 1964 , the Antarctic Treaty Parties designated the Treaty Area a 'Special Conservation Area', (Heap, 1994: 2048) without defining the status, or relating it to legal wilderness as defined elsewhere. In the Protocol's Environmental Principles, *The protection of the Antarctic environment and dependent and associated ecosystems*, together with ... *the intrinsic value of Antarctica, including its wilderness and aesthetic values and its value as an area for the conduct of scientific research...* are declared ... *fundamental considerations in the planning and conduct of all activities in the Antarctic Treaty Area.* Furthermore, although the Antarctic Treaty System has a well-established Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR), co-ordinating research on marine ecosystems and marine environmental management, it has no equivalent covering the terrestrial environment, at which such problems and definitions might be resolved.

Davis (1995a), a member of the PAC team from 1992 to 1994, discussed the intrinsic value of Antarctic wilderness and aesthetic values in relation to visitor management. In her view the danger from tourism in Antarctica is not that visitors may intentionally harm the wildlife or disrupt the environment but that *Antarctica will become a backdrop for all kinds of activities not in keeping with its value as a wilderness* (Davis, 1995a:4). However, although a laudable concern, and one that needs to be expressed, developing conventions or policies to deal with the issue of whether or not such activities are appropriate in wilderness area may well result in conflict with many of the different countries and cultures involved in the Antarctic, each of which would have particular definitions and views of the value of wilderness. A requisite step for developing such policies is a definition of wilderness and aesthetic values for Antarctica which is acceptable to all involved. A study, at present underway, (Codling, *pers.com.*) is attempting to provide such a definition.

2.3 Perceived threats from Antarctic tourism

> *In many regions of the world, tourism now represents a major threat to the environmental integrity of host regions, and hence constitutes a major management problem to be faced by those who are responsible for the protection of host areas and their associated facilities.*
>
> Butler (1991:201)

Despite its isolation, the Antarctic region has been exploited by mankind virtually since its discovery in the early 18th century (see Section 2.4). Interwoven with spells of discovery and geographical exploration, first seals, then whales, and most recently fish, squid and krill have been extracted commercially from the Southern Ocean. In addition both at sea and ashore the region has been important for scientific research, now conducted for well over a century. Since 1958, when the first modern tourist expeditions were made, tourism has become the most recent human activity to invade the region.

Tourism's reputation as a force for environmental and sociological disruption has alerted Antarctic scientists and diplomats to the potential dangers of this recent and increasing industry. Lacking an indigenous population, Antarctica cannot suffer sociological disruption of the kind that has affected many Arctic communities. The threats most often regarded as significant are (a) to Antarctica's role as a continent for science, and (b) to its ecosystems, which many (but not all) polar scientists consider more fragile and vulnerable to disturbance than those of other regions.

2.3.1 Threats to scientific research

In the wake of the substantial contributions to scientific knowledge that resulted from the International Geophysical Year (IGY) of 1957/58, the governments of participating countries, in the Preamble to the Antarctic Treaty (see Appendix 2), recorded the conviction that it was in the interest of all mankind that Antarctica should continue forever to be used exclusively for peaceful purposes, and should not become the scene or object of international discord. Articles I and III of the Treaty designated Antarctica a *...continent for peaceful purposes ... to promote international co-operation and scientific investigation* . The intention was to conserve the region primarily for scientific research.

In support of a claim to priority on the continent, scientists have represented the Antarctic as an essential component of the global environment (e.g. Bonner and Walton, 1985), postulating that the continent holds important information for understanding global systems such as climate change, heat exchange and oceanic systems. Antarctic biota, adapted to survive in harsh conditions, are a valuable source of information for knowledge on physiology, ecology and evolutionary response (Benninghoff, 1987). Thus a case has been proposed that the best use of the Antarctic environment is as a resource for scientific investigation, and that this should take precedence over all other uses.

Unease among scientists at the establishment and subsequent growth of tourism in the Antarctic region is evident in the writings, for example, of Trillmich (1972), Croxall *et al.* (1981), Parker and Angino (1990) and Gardner *et al.* (1997). Representatives of Consultative Parties, commentators and journalists, exemplified by Heap (1987), Roszak (1988), Ackerman (1989) and Manheim (1990), have also expressed concern, chiefly that tourist operations, quite apart from their effects on the natural environment, cannot fail to interfere adversely with scientific operations.

Erize (1987) outlined potential environmental disturbances arising from tourism and suggested methods for control and regulation, many of which (for example instigation of waste management plans, and hiring the best qualified staff and field personnel, see Table 4.2) have been adopted. Erize concluded, however, that tourism is a high-benefit to low-cost resource use, and as such, should be encouraged.

Heap (1987:17) further discusses the potential for prejudicial interference with science and the logistic movements of scientists about Antarctica. Early arguments that tourism might interfere with logistics were validated initially by the disastrous crash of a DC10 tourist aircraft on Mount Erebus in November 1979 (see Section 3.2.1), which disrupted the scientific work of Scott Base and McMurdo Station for the rest of the season. More recent incidents have included the medical evacuation of a tourist through Rothera Station, Adelaide Island in early 1995 which, although paid for by the tourist involved, used a British Antarctic Survey aeroplane, fuel and medical officer (Gemmell, *pers. com.*). Another example was the temporary stranding of a tourist party en route to an emperor penguin colony near Neumayer Station in November 1995, which required their brief accommodation at the station for a few hours (Splettstoesser, *pers.com.*).

An incident often quoted as an example of disruption to science and scientific logistics was the grounding of *Bahía Paraíso*, an Argentine naval vessel, near Palmer Station in 1989, with the spillage of some 600,000 litres of oil, and the consequent disruption of long-term marine biological studies in the area. Although the vessel was carrying 81 tourists, its principle mission was to supply Argentine stations and transport Argentine personnel. The navigational error, which resulted in the wreck, was the consequence of a naval operation, but has been misrepresented as a manifestation of tourism only (Manheim, 1990). That the incident resulted in a series of new scientific investigations to monitoring the consequences of oil spills on an Antarctic marine environment (Penhale *et al.,* 1997) was a useful, if unintentional, consequence (see Section 4.4.1.1).

In 1989 the US National Science Foundation (NSF) met leaders of the Antarctic tour operators who were predominantly American , to promote better relations, and reduce the potential for tourist activities to disturb scientific programmes. This was the first of what has become annual meetings, in which the industry is now represented by the International Association of Antarctica Tour Operators (IAATO). Since 1991, when IAATO was founded, the operators have been represented as observers at Antarctic Treaty Consultative Meetings (ATCMs) also. At meetings with NSF, tour companies are allotted visits to US stations, and are informed of particular research projects which may be sensitive to their operations (Crosbie, *pers. obs.*).

Tourism has also had the opportunity to aid science. For example, researchers and scientific support staff are now often transported aboard tourist vessels (IAATO, 1997a), and tourist visits to Torgersen Island, near Palmer Station, have enabled a natural experiment on the role of unobtrusive human disturbance on the breeding success of Adélie penguins (Fraser and Patterson, 1997). IAATO bylaws and codes of conduct for operators and tourists (see Table 4.2) ensure that operators are not only aware of relevant Antarctic Treaty regulations, but also have an understanding of the location and requirements of research programmes.

2.3.2 Threats to the environment

> *... some ecotour operators admit that no matter how carefully expeditions are run, the very presence of humans can affect a fragile environment... ... Ecoholidays, like mineral and scientific expeditions, will slowly and unwittingly consume one of the planets most scarce valuable and irreplaceable treasures.*
>
> (Masson, 1990: 56, in Hall and Wouters, 1994)

The juxtaposition of high density breeding areas and a concentration of human activity at specific points throughout the Antarctic inevitably provokes concern over ecological disturbance (*e.g.* Stonehouse, 1965; Harper *et al.*, 1984; Young, 1990; Peter, 1991). Most of the Antarctic biota are in coastal locations, with the highest densities located in the Maritime Antarctic (Antarctic Peninsula, the South Orkney and South Shetland Islands: see Section 1.4.1).

Such ice-free coastal areas are the sites most accessible for scientists to establish research stations, and for shipborne tourists to go ashore. Some 28 of a total of 60 permanent and summer-only scientific research stations are found within the Maritime

Antarctic region, and over 95% of shipborne tourist visits are made to this sector (see Chapter 3).

Studies assessing visitor disturbance to wildlife have concentrated primarily on seabird species (e.g. Culik *et al.*, 1990; Wilson *et al.*, 1991; Woehler *et al.*, 1994; Culik and Wilson, 1995; Nimon and Stonehouse, 1995; Nimon *et al.*, 1995, 1996; Fraser and Patterson, 1997). This is because many of the human activities coincide with seabird breeding locations (far more than is the case with marine mammals), and because seabird species are readily apparent and therefore relatively easy to study. This is especially true of penguin species, with the added benefit that there is a wealth of previous research on which to draw. However, seabird numbers are known to fluctuate widely from many causes, and there remain many lacunae in our knowledge of the cumulative effects of human disturbance on Antarctic biota (Emslie, 1997; De Poorter and Dalziell, 1997).

2.4 Earlier human impacts in Antarctica

The Antarctic must not be regarded as a pristine region unmodified by man: its ecosystems have been widely influenced by past human impacts.

Holdgate (1983)

Awareness of the present state of the environment is essential when considering consequences of present activities. Since its earliest exploration and discovery in the 18th century the Antarctic region has been subjected to a wide range of human activities. Impacts ashore from explorers have generally been small and local, although some have left lasting scars. Sealers, and oceanic whalers, had far more extensive and wide-ranging effects, considerably altering marine ecosystems in ways that are still apparent, long after the activities ceased. Current and future impacts from Southern Ocean fishermen, although to some degree controlled by an international convention (CCAMLR, see Section 8.3.1.2), may in their turn prove no less devastating.

2.4.1 Terrestrial environments

The most apparent modifications to the Antarctic terrestrial environment arise from the presence of whaling and scientific installations (Walton, 1987). Whaling is represented by abandoned stations on several sub-Antarctic islands and on Deception Island, and by stores dumps, shore moorings, hulks of several stores ships, and other, lesser installations scattered throughout the Maritime Antarctic, which are today generally considered industrial archaeology rather than rubbish. Early stations and refuges, established during the late 19th and early 20th centuries for exploration and scientific research, include those of the Swedish South Polar Expedition 1901–04 at Snow Hill Island, Hope Bay and Paulet Island, and the huts of four British expeditions to Cape Adare and Ross Island, established between 1899 and 1912. These are valued as historical artefacts.

More recent stations, the earliest dating from World War II, include some that are currently in operation, some closed but clearly cared for, some abandoned, and several derelict. A few of the larger occupied stations include many buildings, roads and airstrips, the largest (e.g. the Teniente Marsh and Bellingshausen complex at Maxwell Bay, King George Island, Esperanza at Hope Bay and McMurdo Station in McMurdo Sound) achieving the size of small towns.

Many of the installations listed above, both during building and after several years' operations, necessarily caused local destruction or displacement of flora and fauna. From several of them contamination has spread to the neighbouring environment (e.g. No Worry Lake, Zhongshan Station, Larsemann Hills was examined by Ellis-Evans *et al.,* 1997); at others the locality has been perturbed by intensive sampling (e.g. Signy Station, South Orkneys as described by Walton, 1987), or suffered introduction of alien species (e.g. *Poa* grass at Arctowski Station, Admiralty Bay, King George Island noted by Smith, 1996). Although cleaning up is possible, and is to some degree being accomplished, many of the changes wrought by these installations are likely to have lasting consequences.

2.4.2 Marine environments

Marine environments on the whole have suffered harsher and more lasting human disruption, notably from sealing and whaling. Although the effects of 19th century sealing are barely discernible, except indirectly in the recent massive increase in number of seals, those of whaling are believed to be more immediately apparent.

The severe reduction in stocks of whales due to hunting is likely to have caused major changes in the demographic patterns of other marine animals which similarly consume krill (Bonner, 1987; Knox, 1994). Many species for which krill is a major food source (for example some penguin species and Antarctic fur seals) have increased substantially in numbers since the reduction in whale populations. If these are cause and effect, Southern Ocean ecosystems are currently adjusting to a major biological perturbation, compared with which effects from tourism are currently trivial, and likely to remain so.

Re-adjustment after anthropogenic disturbance becomes an important issue when trying to measure disturbance from other human sources. It raises the question, for example, of whether maintaining the *status quo* by keeping species diversity and abundance at present levels is valid, or whether it is more important simply to minimise further human-induced changes. The former stratagem may require direct human intervention, for example culling Antarctic fur seals to maintain vegetation stands. The latter would discount such methods, and, to use a terrestrial example outside the Treaty area, might even prohibit the culling of such introduced species as South Georgia's reindeer.

The problem of isolating single, human-induced causes and effects from possible natural changes is also complex, particularly when such disturbances are subtle or cumulative. Although these questions are difficult to assess precisely on the basis of present knowledge, especially with the lack of established baselines, awareness of these issues is essential for monitoring and management programmes.

2.5 Environmental management in Antarctica

> *Land use is the concern of many disciplines and the preserve of none. Its principles are largely those of economics and ecology, but it is the product of human decisions operating within social, political and legal frameworks. It is all too easy to regard land use from single viewpoints such as ecology, economics or law and to forget that it is a multifaceted subject.*
>
> (Mather, 1986: Preface)

In the preface to his book *Land Use* (1986), Mather identifies this important but often-neglected point in land planning, development, management and conservation. Wilson and Bryant (1997) concur. In their view, much current literature on environmental management has adopted a 'state-centric' approach, *i.e.* that environmental policies and practices are the responsibility of the state, rather than products of multi-faceted environmental management in which all users are deeply involved. Sound land-use management practice encourages ... *the interaction of state and non-state environmental managers, with the environment and with each other.*

For several reasons this is a particularly useful concept for environmental management in Antarctica. First, in Antarctica there is no 'state' *per se,* only an international treaty (Appendix 2), under the terms of which co-operation and agreement must be reached between, currently, 26 national Consultative Parties, during an annual two-week meeting. Second, any recommendations, measures and Protocols, born out of co-operation and collaboration, must be adopted into the legislation of each signatory nation, and thus pertain only to their respective nationals. Third, even although citizens of signatory nations are constrained by their own national law while in the Antarctic, enforcement procedures are often far from clear and difficult to execute. Furthermore, the fact that not all individuals visiting Antarctica are citizens of Treaty signatories raises the conundrum of whether or not they are obliged to abide by Treaty recommendations, measures and Protocols, and if so, under whose national jurisdiction shall they come? Finally, as will be shown in this dissertation, the ultimate responsibility in the field for the environmental management of tourism is assumed by a few individuals within the industry (Section 6.3), and it is unlikely that this situation of management will change. In the absence of clear enforcement agents, implementation of management measures continues to depend on the goodwill and co-operation of the industry.

2.5.1 Antarctic Treaty environmental measures

Although primarily concerned with promoting peace and science, Treaty Parties at the first Antarctic Treaty Consultative Meeting (ATCM) discussed the need for the conservation of Antarctic flora and fauna. Negotiations resulted in 1964 in the *Agreed Measures for Conservation of Antarctic Flora and Fauna,* which include procedures to designate Specially Protected Areas and Species, and general rules of conduct for the preservation and conservation of living resources (Heap, 1994: 2085). Following adoption of the *Agreed Measures*, scientific activities in the Antarctic intensified and other uses for the region evolved. The Antarctic Treaty System (ATS) responded by endeavouring to improve environmental management of the continent by a series of *ad hoc* hortatory recommendations, totalling 138 in the first 30 years of the Treaty (Harris, 1993: 267).

Beck (1990, 1994) and Stonehouse (1994b) both summarise considerations by ATCMs of tourist activities, emphasising that, to the time of the formulation of the Protocol on Environmental Protection to the Antarctic Treaty in 1991 (see below), the Parties were concerned more with protecting scientific research from any interference than with attempting to monitor or control the environmental effects of the developing tourist industry.

The most obvious example is the discussion surrounding the designation of Areas of Special Tourist Interest (ASTIs). Delegates to the VIIth ATCM of 1972, aware that cruise ships were landing tourists in Antarctica, recommended (VII-4) that governments ... *consult each other well in advance about the possibility of designating at the eighth ATCM an adequate number of areas of interest to which tourists could be encouraged to go and about the criteria for such areas.* Two years later the eighth ATCM recognised, in Recommendation VIII-9, a need ... *to restrict the number of* *places where large numbers of tourists may land so that the ecological effects may be monitored* (Heap, 1994: 2289 - 2290)

Annex B of the Recommendation provided for *Areas of Special Tourist Interest*, thus gathering tourists in places where their effects could be observed. However, although this concept was further discussed at ATCM XI in 1981, no ASTI was ever designated (Heap, 1994) and no recommendations under the Treaty have since been made to designate areas for tourist use. While areas immediately surrounding scientific stations may be entered only with the station authorities, Specially Protected Areas (SPAs) and Sites of Special Scientific Interest (SSSIs), soon to be rescheduled under Annex V of the Protocol, as Antarctic Specially Protected Areas ~~and Antarctic Specially Managed Areas (ASMAs)~~, require varying levels of permitting and are effectively closed to tourists, tourist expeditions remain free to land anywhere else in the Antarctic.

In the Handbook of the Antarctic Treaty System, Heap (1994: 2287) sets out the main concerns of the Consultative Parties regarding tourism during the period leading up to the Protocol, listing measures up to the XVII ATCM (excluding the Protocol — see below), designed to ensure that:

- *information about tourist and non-governmental expeditions is provided in advance (IV-27(1));*
- *conditions of visits to stations may be made known (IV-27(2), VI-7(2) and VIII-9(2)(a));*
- *scientific research activities are not prejudiced (IV-27 and VI-7);*
- *visitors to the Antarctic that are not sponsored by a Consultative Party are aware of the relevant provisions of the Treaty, Recommendations and accepted practices (VII-4(2), VIII-9 and X-8 Part 1);*
- *the environmental effects of tourism can be monitored (VII-4(3) and VIII-9(3));*
- *provision exists to concentrate the impact of tourism if this should be considered environmentally prudent (VII-4(3) and VIII-9(2)(b); see also extracts from Reports of the IXth and XIIth ATCMs);*

- *tour operators are encouraged to carry experienced guides (X-8, Part III);*
- *Consultative Parties consult each other about non-governmental expeditions organised in one country and requesting assistance from another (X-8, Part II);*
- *non-governmental expeditions, including tourist operations, are encouraged to be self-sufficient and to carry adequate insurance (X-8, Part II).*

In addition to earlier measures concerning tourism, the XVIII ATCM in Kyoto in 1994 adopted a further Recommendation (XVIII-1) on guidance to all visitors to the Antarctic (Appendix 2). Recommendation XVIII-1 will be discussed further in Section 4.3.

The Protocol of 1991(Appendix 3) was an attempt to provide a single coherent set of environmental principles applying to *all* human activities in Antarctica through a set of mandatory rules. Under the Protocol, science and conservation retain high priorities, although other human activities which do not directly jeopardise either the scientific value of the environments or conservation aims are considered *bona fide*. Those engaged in such activities must be aware of the principles of the Treaty and the Protocol, and conduct their activities in ways that do not compromise those principles.

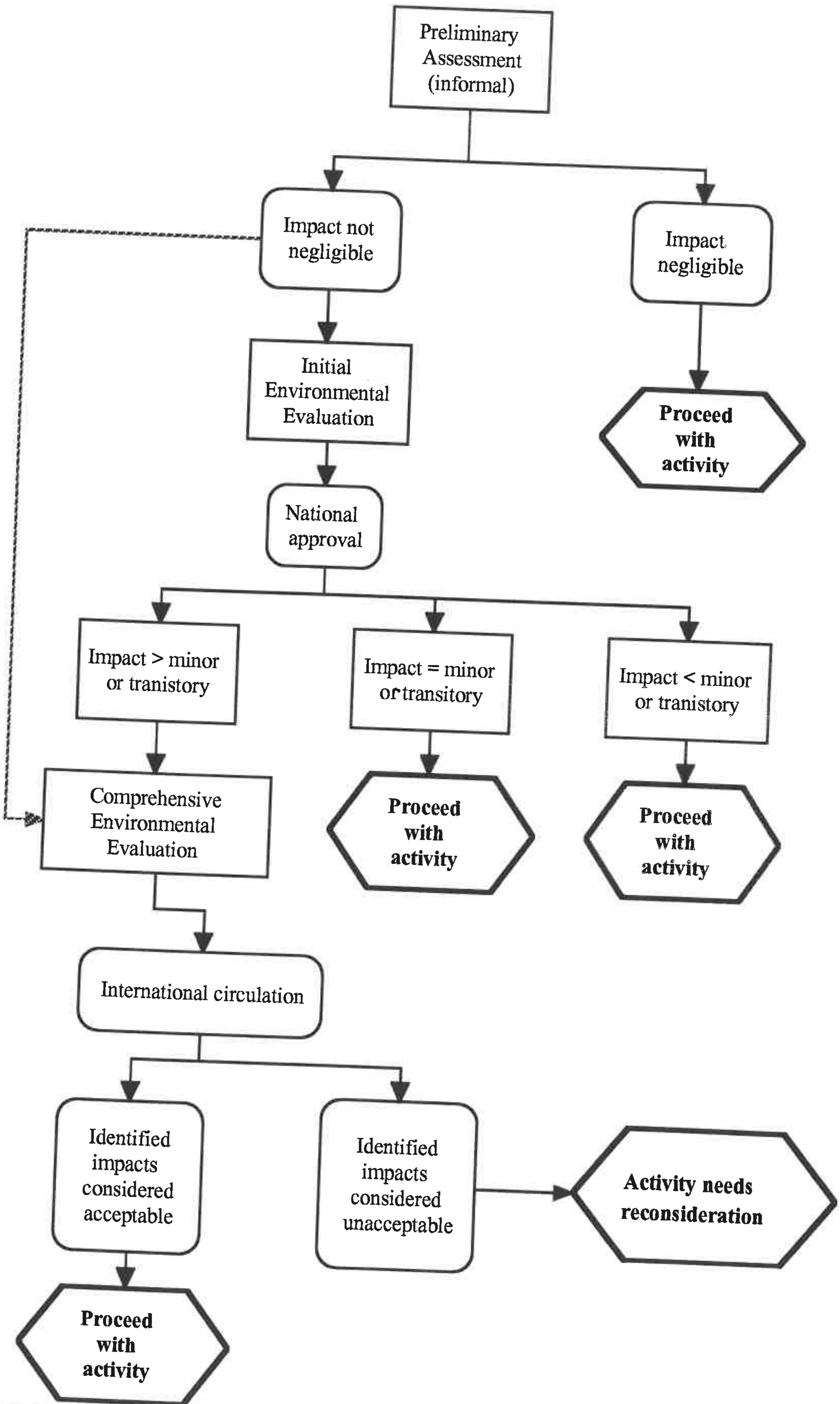
2.5.2 The Protocol and environmental assessments

Under the Protocol, those wishing to engage in any activity in the Antarctic, however minor, must conduct an environmental assessment before beginning. Article 8 and Annex I of the Protocol give details of the stages and requirements for environmental impact assessments. Initial environmental assessments of proposed activities determine whether those activities will have:

- (a) *less than a minor or transitory impact*;
- (b) *a minor or transitory impact*; or
- (c) *more than a minor or transitory impact*

on the Antarctic environment. As the terms *minor* and *transitory* have yet to be clearly defined, these are subjective initial assessments, particularly as there is no central body making standardised evaluations.

Figure 2.1 EIA procedure according to Protocol and Annex I.



Setting aside issues of definition and standardisation, Annex I of the Protocol then outlines procedures depending on the initial assessments. The flow chart in Figure 2.1 illustrates the environmental impact procedure according to the Protocol and Annex I.

Initial assessments are submitted to the government of the country within which the activity was organised (for example, the US State Department if a US tour operator) or is to depart from (for example, the UK Foreign and Commonwealth Office, if departing from the Falkland Islands). If an activity is determined by that government as likely to have a less than minor or transitory impact it may proceed forthwith. If the activity is deemed to have a minor or transitory impact, or a more than minor or transitory impact, Annex I requires one of two kinds of environmental evaluation: an Initial Environmental Evaluation (IEE) or Comprehensive Environmental Evaluation (CEE). Full requirements for IEEs appear in Table 2.2, and for CEEs in Table 2.3.

Table 2.2 Requirements for an Initial Environmental Evaluation (IEE); Article 2 of Annex I to the Protocol (see also Appendix 3).

ARTICLE 2

Initial Environmental Evaluation

1. Unless it has been determined that an activity will have less than a minor or transitory impact, or unless a Comprehensive Environmental Evaluation is being prepared in accordance with Article 3, an Initial Environmental Evaluation shall be prepared. It shall contain sufficient detail to assess whether a proposed activity may have more than a minor or transitory impact and shall include:
   (a) a description of the proposed activity, including its purpose, location, duration and intensity; and
   (b) consideration of alternatives to the proposed activity and any impacts that the activity may have, including consideration of cumulative impacts in the light of existing and known planned activities.
2. If an Initial Environmental Evaluation indicates that a proposed activity is likely to have no more than a minor or transitory impact, the activity may proceed, provided that appropriate procedures, which may include monitoring, are put in place to assess and verify the impact of the activity.

In general terms, an IEE is sufficient if the activity falls into the category of having a minor or transitory impact. It is submitted to the home government for assessment only, and is not circulated for comment to other Treaty Parties. It incorporates a description of the proposed activity *...including its purpose, location, duration and intensity...* and must include consideration of alternative activities, any direct impacts, and potential cumulative impacts. If they indicate only minor or transitory impacts then the activity may proceed *...provided that appropriate procedures, which may include monitoring, are put in place to assess and verify the impact of the activity* (Annex I, Article 2.2).

Table 2.3 Article 3 of Annex 1 of the Protocol: Requirements for a Comprehensive Environmental Evaluation (CEE).

ARTICLE 3

Comprehensive Environmental Evaluation

1. If an Initial Environmental Evaluation indicates or if it is otherwise determined that a proposed activity is likely to have more than a minor or transitory impact, a Comprehensive Environmental Evaluation shall be prepared.
2. A Comprehensive Environmental Evaluation shall include:
   (a) a description of the proposed activity including its purpose, location, duration and intensity, and possible alternatives to the activity, including the alternative of not proceeding, and the consequences of those alternatives;
   (b) a description of the initial environmental reference state with which predicted changes are to be compared and a prediction of the future environmental reference state in the absence of the proposed activity;
   (c) a description of the methods and data used to forecast the impacts of the proposed activity;
   (d) estimation of the nature, extent, duration and intensity of the likely direct impacts of the proposed activity;
   (e) consideration of possible indirect or second order impacts of the proposed activity;
   (f) consideration of cumulative impacts of the proposed activity in the light of existing activities and other known planned activities;
   (g) identification of measures, including monitoring programmes, that could be taken to minimise or mitigate impacts of the proposed activity and to detect unforeseen impacts and that could provide early warning of any adverse effects of the activity as well as to deal promptly and effectively with accidents;
   (h) identification of unavoidable impacts of the proposed activity;
   (i) consideration of the effects of the proposed activity on the conduct of scientific research and on other existing uses and values;
   (j) an identification of gaps in knowledge and uncertainties encountered in compiling the information required under this paragraph;
   (k) a non-technical summary of the information provided under this paragraph; and
   (l) the name and address of the person or organisation which prepared the Comprehensive Environmental Evaluation and the address to which comments thereon should be directed.
3. The draft Comprehensive Environmental Evaluation shall be made publicly available and shall be circulated to all Parties, which shall also make it publicly available, for comment. A period of 90 days shall be allowed for the receipt of comments.
4. The draft Comprehensive Environmental Evaluation shall be forwarded to the Committee at the same time as it is circulated to the Parties, and at least 120 days before the next Antarctic Treaty Consultative Meeting, for consideration as appropriate.
5. No final decision shall be taken to proceed with the proposed activity in the Antarctic Treaty area unless there has been an opportunity for consideration of the draft Comprehensive Environmental Evaluation by the Antarctic Treaty Consultative Meeting on the advice of the Committee, provided that no decision to proceed with a proposed activity shall be delayed through the operation of this paragraph for longer than 15 months from the date of circulation of the draft Comprehensive Environmental Evaluation.
6. A final Comprehensive Environmental Evaluation shall address and shall include or summarise comments received on the draft Comprehensive Environmental Evaluation. The final Comprehensive Environmental Evaluation, notice of any decisions relating thereto, and any evaluation of the significance of the predicted impacts in relation to the advantages of the proposed activity, shall be circulated to all Parties, which shall also make them publicly available, at least 60 days before the commencement of the proposed activity in the Antarctic Treaty area.

A CEE is required if the activity is deemed to have a greater than minor or transitory impact. It must be circulated to all Treaty Parties for review and comments, and be available for public comment and consideration at the following ATCM. It must also incorporate post-evaluation monitoring procedures.

Post-evaluation monitoring is completed by those who are participating in the activity and submitted to the relevant authority for approval. The aims of both the requisite post-evaluation monitoring of CEEs and the possible post-IEE monitoring are detailed in Annex I, Article 5.2 of the Protocol to:

- *(a) enable assessments to be made of the extent to which such impacts are consistent with the Protocol; and*
- *(b) provide information useful for minimising or mitigating impacts, and, where appropriate, information on the need for suspension, cancellation or modification of the activity.*

National interpretations of these requirements are inevitably varied. As successive Consultative Parties ratify the Protocol, they must incorporate its provisions into national legislation. For example, in the UK it was enacted through the *Antarctic Act* of 1994, with the regulations for permits being drawn up to come into force within two years: in the USA the Protocol was enacted through Public Law 104-227, the *Antarctic Science, Tourism and Conservation Act* of 1996, again with two years to bring regulations into force. While the former has one set of regulations for all national activities in the Antarctic, the latter has separate regulations for governmental and non-governmental operators.

As IAATO and the majority of tour operators are US-based, IAATO is conforming with US regulations on behalf of its members. As the largest percentage (37–50% annually since 1989/90) of all passengers carried are of US nationality (NSF/IAATO 1997), and since it appears that certain governments are able to waive their own requirements if ... *it can be demonstrated that the cruise has written authorisation from another Contracting Party to the Protocol* (extract from a letter from the UK FCO to Explorer Shipping Corporation), the following section concentrates particularly on US regulations.

2.5.3 Enacting Protocol requirements

Under the US Antarctic Science, Tourism and Conservation Act of 1996, the US Environmental Protection Agency (US-EPA) has recently been directed to ... *promulgate regulations that provide for assessment of the environmental impacts of non-governmental activities in Antarctica* ... (US-EPA, 1997: D2). The USA is currently the only country that is enacting separate regulations for non-governmental and governmental activities, although the former are based on the latter. US-EPA initiated an Interim Final Rule in April 1997, which is intended to cover the period until the Final Rule, originally to be promulgated in April 1999, but is being postponed until April 2001. Under the Interim Final Rule, tour operators are required to file an IEE no fewer than 90 days prior to the proposed departure. The Interim Final Rule also requires operators to employ procedures to assess and provide a regular and verifiable record of the actual impacts of that activity.

Criteria listed by US-EPA for assessment and verification of impacts, here shown in Table 2.4, are designed (1) to determine impact consistency with the Protocol, and (2) to provide information useful for minimising and mitigating impacts, and identify need for suspension, cancellation or modification of activity. They differ only slightly from the established Treaty Post-Visit Report Form which, under Treaty ruling, must already be submitted to respective national governments (Appendix 4).

Table 2.4 Measures to assess and verify impacts as per US Interim Final Rule for Environmental Impact Assessment of Non-governmental activities in Antarctica. Source US-EPA Public Scoping Meeting handout 1997

For activities requiring an IEE
1. Number of tourists ashore by site
2. Number of landing sites
3. Location of landing sites
4. Total tourists at each site per ship
5. Total tourists at each site for season
6. Number of times sites visited in past
7. Number of times site expected to be visited
8. Times of year visits expected to occur (e.g. before, during, after penguin breeding season)
9. Number of visitors ashore by site per visit
10. Visitor activities while at site
11. Verify tourist guidelines followed
12. Describe exceptions to landing guidelines
13. Describe any activity requiring mitigation, mitigation actions taken and outcome

While this information is useful for identifying numbers of visitors that have landed at different sites during the season, it contributes little to the knowledge of their impacts. Given the lack of facts on the effects of tourism on the Antarctic environment, the non-obligatory post-IEE monitoring required under Annex I, Article 2 of the Protocol, and the time in which the Interim Final Rule was drawn up, this approach is understandable. Yet, in view of the lack of definite data on the effects of tourism on the Antarctic environment, in particular the consequences of frequently repeated visits to sites, this form of assessment and verification is inadequate and barely in keeping with the environmental principles of the Protocol.

A possible solution to this problem could be developed through the Committee for Environmental Protection (CEP), which is now being formed as the Protocol has come into force. Under Article 12.1 of the Protocol, the Committee is designed to *provide advice and formulate recommendations ... in connection with the implementation of this Protocol including the operation of its Annexes* , with eleven listed functions which include providing advice and information on the state of the environment and the need for environmental monitoring (Article12:1j&k — Appendix 3). Thus it may become possible for Treaty Parties to seek advice from the CEP on measures for monitoring for cumulative impact from tourist activities (Heap, *pers. com.*).

To substantiate this concept, in 1995 at the XIX ATCM, the need for tourism impact monitoring was again recognised, and in further detail (XIX ATCM report, paragraph 61):

> *Existing information generally is insufficient either to predict or to serve as a baseline for detecting environmental impacts of Antarctic tourism. Therefore, the Meeting urged Parties to support activities toward:*
>
> *a) identifying sites that possibly have been or may be affected by tourism in Antarctica, and control sites that may be used in comparison;*
> *b) surveying selected sites and, if possible, determine indicator variables most likely to be sensitive to tourism activities; and*
> *c) determining and evaluating the effectiveness of measures taken to minimise the impact of different types, frequencies, timing and levels of tourism activities*

This indicates that, within the ATS, there is a need perceived for more detailed monitoring of tourism and its potential impacts than is provided for under the Protocol.

Means of monitoring tourism under the Protocol became effective when the instrument was eventually ratified on 14 January 1998. Then for the first time in the history of the Antarctic Treaty, scientific and tourism activities were brought officially under the aegis of Treaty Parties equally.

2.6 Discussion and conclusions

Antarctic tourism forms part of the world-wide movement of nature tourism, a rapidly expanding market popular among many travellers. Antarctic tour operators aspire to an environmentally sensitive and sustainable form of nature tourism. While Antarctic tour operators show commendable environmental sensitivity, there is at present insufficient evidence to support claims that their forms of tourism are sustainable.

Antarctica is represented to potential tourists as 'wilderness', a term widely used by many concerned with the continent. However, the term lacks the legal conciseness that it currently has under laws and conventions applicable elsewhere in the world. The concept that Antarctica has *intrinsic wilderness and aesthetic values* is probably acceptable to all parties; however until a legal definition — which is compatible with the continent's status as a Special Conservation Area — is specified, clear environmental objectives will be difficult to define.

The reputation of tourism elsewhere in the world has contributed to suspicions that in the Antarctic it cannot fail to be harmful to scientific research and to the environment. While its effects on research may readily be assessed, its possible adverse effects on ecosystems are more difficult to determine, because of continuing perturbations from earlier human activities, notably sealing and whaling, as well as natural environmental changes.

The Antarctic Treaty's measures for environmental protection culminated in the 1991 Protocol on Environmental Protection, which seeks to control all human activities in the Antarctic region, including tourism, through a system based on environmental impact assessments. Because most Antarctic tour operators, and their trade organisation, are US-based, they will be affected most by legislation and practices that are currently being developed there to conform to its responsibilities imposed by the Protocol. The Interim Final Rule, the present basis for legislation, specifies procedures for verification of assessments that seem inadequate, and not in keeping with the principles of the Protocol, but those procedures remain to be tested.

Chapter 3

Antarctic tourism: scale and environmental context

3.1 Introduction

Tourist visits to Antarctica during the last 40 years have been listed by several authors, for example, Reich (1980), Headland (1994), and Stonehouse (1994a). The status of Antarctic tourism was most recently examined by Enzenbacher (1994) up to the 1992/93 season. Since then, no analysis of data for all forms of Antarctic tourism has been published. However, annual statistics of shipborne tourism to the region, compiled by the US National Science Foundation (NSF) in collaboration with IAATO, indicate almost a doubling in numbers of shipborne tourists alone since Enzenbacher's report, and other sources give strong indications that all other forms of tourism have similarly increased.

This chapter describes Antarctic tourism in its four main categories, two airborne (overflights and flights that include landings) and two seaborne (yachting enterprises and shipborne expedition cruising). Of the four, all but the first include tourists actually setting foot in the Antarctic, and the fourth is by far the largest and most likely to affect Antarctic environments. The chapter assesses the development of all categories of Antarctic tourism, in the environmental context, estimates their activities, and evaluates their varying levels of environmental disturbance.

3.2 Airborne tourism

Flights over the continent currently involve several thousands of tourists each season. They are exceptional in that they avoid direct contact with the Antarctic environment. Flights that include landings, mainly to inland destinations where there is very little wildlife, carry adventure expeditions, sometimes extending to prolonged stays on the continent. They carry far fewer passengers than either overflights or shipborne activities, but have direct contact with the Antarctic environment over a wide geographic area; they permit the only substantial inland human activity.

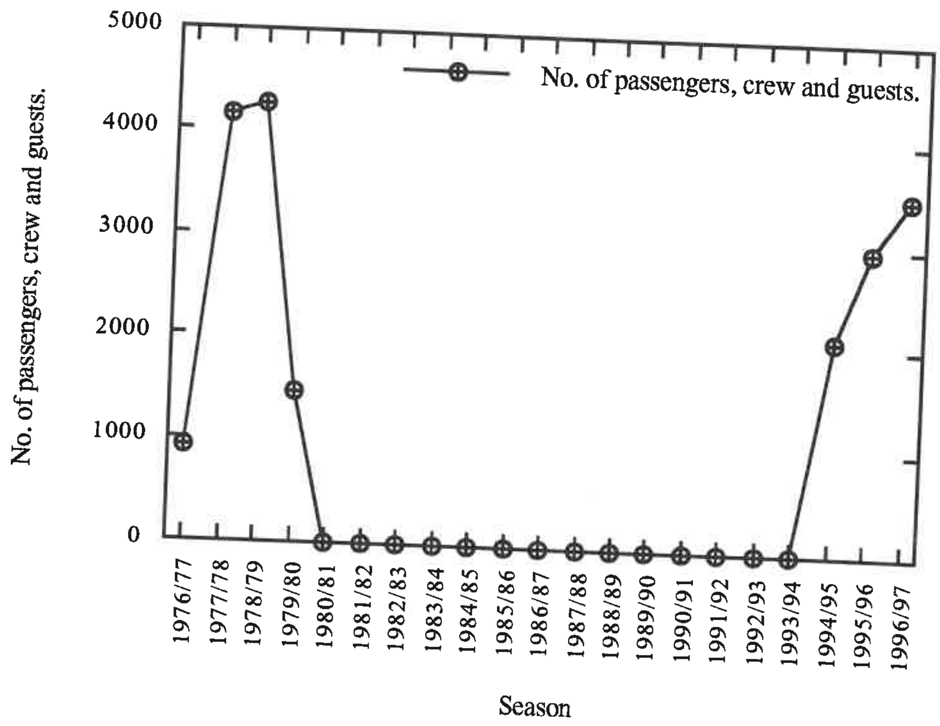
3.2.1 Overflights

Early tourist flights over Antarctica are reviewed by Reich (1980) and Boswall (1986). The first tourist overflight was a sight-seeing flight from Chile in December 1956, over the Antarctic Peninsula area (Reich, 1980). Overflights did not become a regular feature until 21 years later, when, between January and March 1977, Qantas and Air New Zealand, operating respectively from Australia and New Zealand, made five flights over the Ross Sea and Victoria Land.

Between 1977 and 1979/80 these flights became a popular way to see the Antarctic continent, a total of 44 flights carrying an estimated 11,145 tourists (Reich, 1980). They terminated after an Air New Zealand DC10 crashed into Mount Erebus, near McMurdo Station (Map 1.1), on 28 November 1979, killing all 257 aboard (Auburn, 1982).

Except for occasional overflights offered by the Chilean airline LADECO (Enzenbacher, 1993a), this form of tourism lapsed until the 1994/95 season, when Qantas resumed flights off the coast of Terre Adélie and the Ross Sea, using Boeing 747-300 aircraft with capacity for 386 passengers. Marketed by Croyden Travel Centre, Melbourne, these have again become a popular form of tourism. Flights last approximately 12 hours. To improve viewing opportunities, only 299 seats are sold, and passengers exchange seats halfway through the flight. There are lectures and videos during the flight, and the aircraft maintain an altitude of approximately 3000 metres over the Antarctic continent (Headland and Keage, 1995).

Figure 3.1 Annual number of passengers on overflights of Antarctica since 1977. Sources: Reich (1980); Headland, (*pers. com).*



Since the first such flight on 31 December 1994, a total of 25 overflights of Antarctica, up to and including the 1996/97 season, have carried approximately 8600 passengers (Figure 3.1). Currently, no other scheduled flights of the continent are offered.

Swithinbank (1993a) assesses the environmental effects of these flights in two categories: pollution from hydrocarbon emissions; and possible disturbance of wildlife populations from noise. The height at which the flights operate, in a zone of strong upper winds, makes the possibility of hydrocarbons reaching Antarctica likely to be low. Tourist flights represent a small addition to the relatively much larger number of flights by US and other government expeditions in the same Antarctic sector. During 1996/97 there were only 10 tourist overflights, while expedition flights between

Christchurch and McMurdo Station were several per week from October to February inclusively, and there were regular flights also between McMurdo and South Pole Station from November to January. Since aircraft produce more hydrocarbon emissions during take-off and landing, again government expedition flights are likely to cause much more pollution than tourist flights.

Disturbance to wildlife is most likely to result from flights in the vicinity of coastal breeding sites. Hall and Wouters (1994) refer to a report that alleged that a stampede resulting in the death of 6,000 king penguins on Macquarie Island in June 1990 was caused by an aircraft (*The Australian*, 25 June, 1990). However altitudes were not mentioned and Sladen and LeResche (1970) reported that the minimum height at which nesting penguins reacted to a helicopter (LH-34) or fixed-wing aircraft (De Havilland Otter) was between 762 and 914 m, well below the minimum of 3000 metres maintained by overflights. To date, there is no evidence to suggest that high altitude flights affect Antarctic wildlife (Swithinbank, 1993a).

Thus resurgence in Antarctic overflights does not appear to impose measurable burdens on either the environment or wildlife.

3.2.2 Flights that include landings

A Pan-American stratocruiser, flown from Christchurch and landing at McMurdo in 1957, was the first flight that included tourists. Since then, the growth in tourist flights that landed has been erratic (Reich, 1980; Enzenbacher, 1993b; Swithinbank, 1988, 1989, 1990, 1992a, 1992b, 1993b, 1994, 1995, 1996, 1997b). Prior to the 1980s such flights occurred occasionally and, usually, to the McMurdo airstrip (Reich, 1980).

Fuerza Aérea Chile (FACH) and Aérovias DAP of Punta Arenas offered irregular flights to the Chilean Station Teniente Rodolfo Marsh on King George Island (see Map 1.2) carrying approximately 40 people per trip. These flights are primarily for military purposes and are used to service and re-supply stations, but since the 1983/84 summer have been used occasionally to carry tourists (Enzenbacher, 1993b).

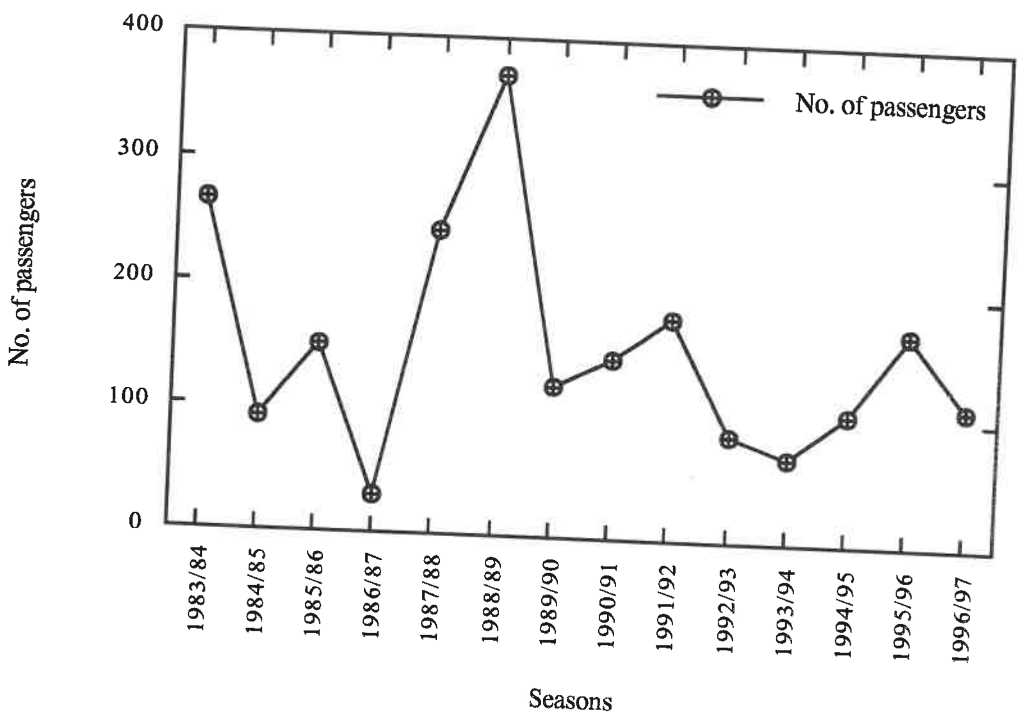
3.2.2.1 ANI operations

The main development in non-governmental flights that include landings occurred in 1985 with the advent of Adventure Network International (ANI), a commercial airway (Swithinbank, 1988, 1993a). Initially ANI's Antarctic Airways operated a chartered Twin Otter from Punta Arenas to the vicinity of Vinson Massif (Sentinel Range, Ellsworth Mountains). These flights required two refuelling stops at 67°S and 72°S on the Antarctic Peninsula where fuel was deposited by ship. In 1987/88 ANI expanded its Antarctic operations by establishing a camp at Patriot Hills in the Ellsworth Mountains (see Map 1.1). This was made possible by a nearby area of blue ice (compact, snow-free surface) suitable for a runway and thus enabling larger aircraft (for example, C130s) to fly directly from Punta Arenas (Swithinbank, 1988).

Since then, ANI has continued to transport many private expeditions such as the Pentland South Pole Expedition led by Sir Ranulph Fiennes and the Kazama Motorcycle Expedition to the South Pole (Swithinbank, 1992b; 1993b). ANI also transports visitors to other destinations: the South Pole, the emperor penguin colony at Dawson-Lambton Glacier, the base of Vinson Massif — Antarctica's highest mountain (4985 m) — in the Sentinel Range of the Ellsworth Mountains, the Transantarctic Mountains and since 1996/7 they have offered flights from Cape Town, South Africa to Dronning Maud Land (see Map 1.1) (ANI, 1997; Swithinbank, 1997a). Thus ANI have developed a logistical capacity to transport private expeditions to continental Antarctica that is distinct from any governmental operations.

Figure 3.2 shows annual totals of passengers landed from tourist flights since 1983/4. Attempts to establish exact numbers of flights and passengers carried are hindered by scattered data sources. In Figure 3.2, numbers of passengers between 1983/84 to 1991/92 are those reported by Enzenbacher (1993b) which include all airborne tourists, although there were virtually no overflights during this period (see Section 3.2.1). Although unconfirmed, single overflight by LADECO (Enzenbacher, 1993b) would explain the peak in the 1988/89 season .

Figure 3.2. Number of passengers landed annually from Antarctic tourist flights since 1983/4.
Sources: Enzenbacher (1993b), Swithinbank (1990, 1992a, 1992b, 1993b, 1994, 1995, 1996, 1997b).



Post-1991/92 figures are primarily ANI flights, reported annually by Swithinbank in *Polar Record* (see references). Figures for flights and passengers carried by Chilean companies are not available. As a result, number of passengers from the 1992/93 season to the present can be taken as an underestimate of the actual totals. Despite these discrepancies, Figure 3.2 illustrates that the numbers of passengers involved in this form of tourism are low, oscillating between fewer than 50 and 300 per season.

3.2.2.2 ANI: environmental assessment

Activities in this form of tourism, which include scenic flights, carrying climbers to their destinations, and visits to emperor penguin colonies, have the potential to effect wildlife, arising both from the flights and from camping and direct human contact. Environmental impact assessments for all ANI Antarctic operations have been completed by Poles Apart, an independent polar environmental consultancy (Poles Apart, 1994). Their report includes the following observations.

The inland regions in which most ANI activities take place have very few biota. Vegetation is very sparse, primarily lichens on ice-free ground of nunataks and mountain ranges. ANI visitors who have visit such ground near the camps are warned to avoid trampling on vegetation. Only the fuel depot in Antarctic Peninsula, and the emperor penguin colonies of the Dawson-Lambton Glacier, are in Maritime or coastal Antarctic environments.

The fuel depot sites in the Maritime Antarctic are situated on ice shelves well clear of breeding sites or areas of extensive vegetation. Empty fuel drums are removed by ship when the depot are restocked. Numbers of clients visiting the Dawson-Lambton colony are low (about 15 per season, in small groups). Visitors arrive by Twin Otter or Cessna aircraft in mid-to-late November, when the chicks are creching, and a tented camp is established 600 metres from the colony. Visits usually last two to four days. Four field guides accompany each party. Through strict codes of conduct, disturbance to the birds is minimal. For example, aircraft do not go within 1 km of the colony, visitors are advised not to walk within 20 metres of the colony, and they are constantly monitored by staff.

A primary environmental concern is removing all traces of visitor presence. Poles Apart staff found ANI's operational planning, execution and monitoring of activities to be consistent with the requirements of the Protocol, but made a series of minor recommendations with respect to waste management, emergency procedures, and operational procedures. Examples of the recommendations were the formal preparation of a waste management plan, the establishment of a contingency plan for fuel spills and staff training on requirements of the Antarctic Treaty System, including the Protocol.

Thus, although this form of tourism has the widest geographic spread, the very low numbers involved, operational procedures established and the fact that activities occur in areas of very sparse biota, suggest that it has no measurable adverse effects on the Antarctic biome.

3.3 Seaborne tourism

Far more tourists visit the Antarctic by sea than by air. This is principally because seaborne vessels are self-contained and require no permanent structure ashore; thus operations can be designed to accommodate large groups of people and transport them easily between locations. Like airborne tourism, seaborne tourism can be divided into two categories on widely differing scales: small-scale activities involving privately operated or chartered yachts, and large-scale shipborne tourism, which currently brings by far the greatest numbers of tourist to Antarctica.

3.3.1 Yachts

No reliable records of the numbers of yachts and their passengers visiting the Antarctic each season exists. The following is collated from a variety of sources, and relies heavily on personal communications.

The first recorded visit by a small private yacht to the Antarctic was that of *Mischief*, skippered by Bill Tillman in 1966/67 (Reich, 1980; Headland, 1989). Yachts continued to visit the Antarctic and Sub-Antarctic only sporadically until the mid 1980s after which the number of visits increased.

Yachts are used either by the owners for personal cruises, seeking simply to visit Antarctica for their own interest, or by private expeditions under charter, catering for such specific interests as mountaineering or film-making. The duration of individual voyages is often dictated by fuel, water and food-carrying capacity. While most voyages last only between four to six weeks, some yachts have wintered in the Peninsula region. For example, in 1990 the Swedish *Northern Light* and the French yacht, *Oviri*, spent the winter near Pleneau Island, just south of the Lemaire Channel. The latter suffered the indignity of being frozen to the bottom at low tide, only to be swamped when the tide rose (Cranney and Stark, 1990).

The number of people carried on yachts range from one or two, predominantly the owners on personal expeditions, to a maximum of 15 to 17, usually on chartered expeditions. Yacht expeditions are monitored by various interested individuals (e.g. Poncet, *pers. com.*), noted by other ships, and logged during visits to Antarctic stations (Shears, *pers. com.;* Jatko, *pers.com.*). At specific ports, for example Punta Arenas, Chile, Ushuaia, Argentina, or Stanley in the Falkland Islands, harbour records note the next port-of-call, although Antarctica is not always considered to qualify as such (Crosbie, *pers. obs.*). Instituo Fueguino de Turismo - Oficina Antártica the Argentine tourism agency responsible for Tierra Del Fuego, records yachts that leave from Ushuaia for the Antarctic (Galimberti, *pers.com.*).

Table 3.1, listing the number of yachts estimated to have visited Antarctica during five-year periods from 1959-60, indicates a sharp increase in the number of yachts during the 1980s and 1990s. This trend may have been accelerated by technological improvements available to yachtsmen, for example in navigational equipment. However, it represents also the general increase in awareness of the attractions of Antarctica, possibly stimulated by word-of-mouth within the yachting community, articles in yachting magazines (e.g. Carr and Carr 1996; Quitmann, 1997), and possibly, to some degree, by Poncet and Poncet's (1991) *Handbook for Southern Ocean Cruising.*

Table 3.1 shows also that most yachting is concentrated in the Maritime Antarctic region, rather than at coastal locations around the continent, primarily because of the proximity to South America and the Falkland Islands. The Maritime Antarctic, once it has been reached across Drake Passage, offers a wide extent of reasonably sheltered waters, as well as direct contact with dense wildlife communities, sites of historic interest and scientific operations, and spectacular scenery — more attractive to yachtsmen than the kilometres of barren ice cliff and difficult ice conditions found elsewhere around the continent.

Table 3.1 Number of yacht visits to the Southern Ocean region in five-year periods from the 1959/60 season. Sources: British Antarctic Survey Archives; Headland (1989); and Poncet (*pers.com.*).

Five-year periods	Total yacht visits	Areas visited
1959/60 - 1963/64	1	Sub-Antarctic
1964/65 - 1968/69	1	Sub-Antarctic
1969/70 - 1973/74	6	Sub-Antarctic and Maritime Antarctic
1974/75 - 1978/79	8	Sub-Antarctic Maritime Antarctic and 1 to Cape Adare
1979/80 - 1983/84	17	Sub-Antarctic Maritime Antarctic
1984/85 - 1988/89	41	Sub-Antarctic Maritime Antarctic and 2 to Cape Adare
1989/90 - 1993/94	72	Sub-Antarctic Maritime Antarctic
1993/4 - 1996/97* Note: four years only.	47	Sub-Antarctic Maritime Antarctic

Although the number of yachts visiting Antarctica annually remains low, the potential environmental impacts of the yachting community are high, and a cause for concern among those who seek to control the effects of tourism. Yacht personnel, who often come into close, direct contact with Antarctic wildlife and vegetation, vary considerably in terms of their awareness of Treaty regulations and environmental responsibility. Some who operate regularly in Antarctic waters, and are aware of regulations and responsibilities, have attended IAATO and other relevant meetings: recently two, the French operators of *Croisieres-Australis* and UK operators of *Pelagic*, have become members of IAATO (Schoeling, *pers. com.*). Nevertheless, each season sees the advent of two or three new and inexperienced yacht operators, with little or no cognisance or regard of either the regulations or the codes of conduct appropriate to the region.

Within the author's personal experience, two yacht operators brought dogs ashore at locations in the Antarctic Peninsula in 1994/95 and 1995/96. The annual report from Faraday Station, 1989/90 (Cranney and Stark, 1990), indicated a similar happening, and voiced general concern over yacht operations, noting in particular:

- littering around the yacht;
- animals and eggs taken for food;
- vegetation taken for decoration;
- trampling of vegetation;
- touching or handling of birds and seals;
- introduction of alien species;
- encroachments on Specially Protected Areas (SPAs);
- removal of equipment from unoccupied bases;
- misuse of refuges;
- requests to use base facilities.

Several publications have sought to increase the environmental awareness of the yachting community in Antarctic waters, for example *Southern Ocean Cruising* (Poncet and Poncet, 1991), the *Lonely Planet* Guide to Antarctica (Rubin, 1997), yachting magazine articles, information packs provided by Instituo Fueguino de Turismo - Oficina Antártica (see above) at Ushuaia and most recently the *Oceanites Site Guide to the Antarctic Peninsula* (Naveen, 1997a). However, these are more likely to be read by charter operators, already the most responsible yachtsmen, than by the novices whose activities pose the most serious challenges to implementation of the Protocol's protective measures.

3.3.2 Expedition cruising

The first ships bringing modern day tourists to the Antarctic were Chilean and Argentine vessels which made visits in 1958 and 1959 (Reich, 1980). Regular passenger voyages began in 1966, when Lindblad Travel Inc., owned and operated by Lars-Eric Lindblad, brought paying passengers to the Peninsula aboard *Lapataia* (Lindblad and Fuller, 1983). This voyage was significant in setting the pattern for report from Faraday Station, 1989/90 (Cranney and Stark, 1990), indicated a similar happening, and voiced general concern over yacht operations, noting in particular:

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3.3.2.1 The Lindblad pattern

The Lindblad pattern of cruising emphasises exploration and education. Vessels used in polar waters are selected for their ice capability and the experience of their officers and crew. Most are ice-strengthened, some are icebreakers: with a few exceptions (see below) they carry between 40 and 140 passengers. Expedition cruises to the Maritime Antarctic last approximately eight to 17 days, allowing four days in return transit across the Drake Passage, and at least four and up to 13 days in Antarctic waters. Cruises to other Antarctic regions normally take longer, usually up to 21 days and as many as 30 to 35 days, primarily because of the distance between ports and destinations.

Throughout the voyages, the vessels allow wildlife and scenic observation. Excursions from the ship use inflatable boats (usually Zodiacs) powered with 40/50 hp outboard engines, which carry a driver and up to 12 passengers. In areas outwith the Maritime Antarctic, helicopters (routinely carried by icebreakers, occasionally by other passenger ships) may be used to visit emperor penguin colonies and other sites inaccessible to boats.

During each cruise to the Maritime Antarctic opportunistic landings at, and excursions to, sites on the Peninsula and offshore islands are made. These include areas of scenic, geological, biological or historic interest, scientific stations, and areas where particular activities are possible, for example hiking or swimming in geothermally-heated water. Throughout the cruises, both afloat and ashore, passengers are guided by experienced staff and naturalists. Lectures are given en route between destinations, often by retired or vacationing scientists or administrators experienced in Antarctic affairs.

Before landing in Antarctica, passengers are briefed on the Antarctic Treaty and issued with the Visitor Guidelines (Appendix 2). At evening 'recap' sessions the day's events are discussed and plans announced for the following day. These become important occasions for reinforcing the expedition spirit and reiterating the conservation ethic (Stonehouse, 1994a; Stonehouse and Crosbie, 1995).

Major differences in operations arise from different carrying capacities of the cruise ships. *Marco Polo* and *Vista Mar* carry the greatest number of passengers (500 and 300 respectively), *Bremen* and *Hanseatic* each carry approximately 180, *World Discoverer* up to 138, *Kapitan Khlebnikov, Explorer*, and *Alla Tarasova* (now *Clipper Adventurer*) each about 100, *Akademik Ioffe* and *Akademik Vavilov* up to 80 passengers. The smallest refitted scientific research ships carry only 30 to 50 passengers.

For several reasons the Lindblad pattern has proved effective with ships of up to about 150 passengers. Under IAATO rules, (Section 4.2) only 100 passengers may be ashore at any time. Therefore ships with more passengers take longer to land them: *Explorer* might take 3 hours to land 90 passengers at a site, while *Marco Polo* requires at minimum five hours to land five groups of 100 passengers.
Passengers in small groups can get ashore quickly, spend two or three hours at a site, and make two or three landings per day; those in larger groups must be content with brief landings, waiting in turn for their opportunity to go ashore, and fewer landings overall. For similar reasons the pattern of on-board activities shifts. Lectures may compete for time and space with such traditional cruise-ship entertainment as bingo, casinos and floor-shows while dinners taken in two sittings erode important evening recap sessions (Stonehouse, 1994a).

3.3.2.2 Data sources

There are two main sources of data about shipborne tourism to Antarctica. Since 1988 the US National Science Foundation (NSF) has been collecting and to some degree collating data from cruise ships, mainly through post-visit report forms (Appendix 4). In addition, since 1993 Instituo Fueguino de Turismo - Oficina Antártica (Section 3.3.1) has collected data on vessels which used Ushuaia. As NSF records cover a longer period, much of the following analysis is based on these data (see also Chapters 4 and 5).

Initially, only US tour operators were obliged to submit post-visit reports to the NSF. Since the establishment of IAATO, member companies of other nationalities have agreed to contribute similar reports. Methods of collection have introduced uncertainties. Although recorded on standardised forms, the data are collected on the ships by expedition leaders, some with little experience or knowledge of the purpose, others with idiosyncratic interests and priorities, which NSF and IAATO collators cannot be expected to take into account.

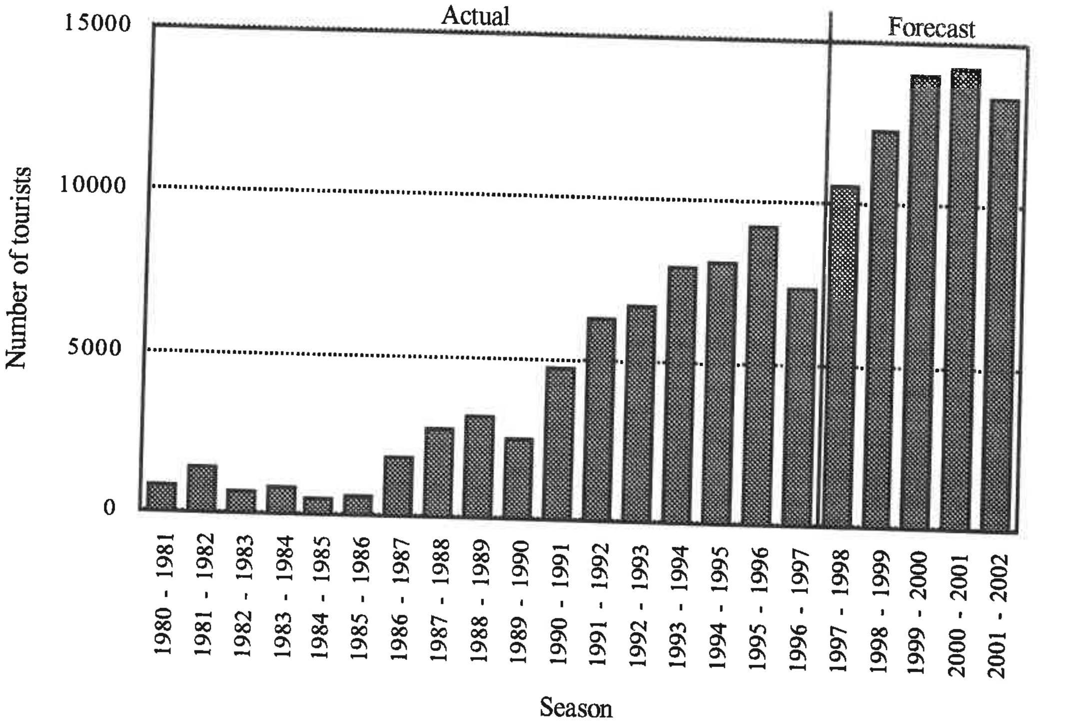
It becomes clear on studying the data that, for example, some recorders have entered names of landing sites and numbers of passengers ashore inaccurately, and inclusion of certain activities, such as Zodiac cruises has been haphazard. Where it is possible to check records against other sources, inconsistencies appear: Enzenbacher (1994) noted that during 1992/93 NSF records show 1589 passengers landing on Cuverville Island, while researchers on the island counted 1950 landed, with a further 435 taking part in Zodiac cruises (see Appendix 6). Acknowledging these problems, both NSF and IAATO have made efforts to standardise collection, recording and collation procedures to improve accuracy. Despite such discrepancies, this database remains an invaluable record of the number of vessels, passengers, and operators working in Antarctica since 1987/88.

3.3.2.3 Trends in numbers

Figure 3.3 incorporates NSF data with other sources to show the total numbers of tourists visiting the Antarctic aboard cruise ships annually from 1980/81 to 1996/97. Despite fluctuations, numbers have increased substantially during that period.

Fluctuations may be attributed to a variety of causes. In 1982 and the following season low numbers could be attributed to the Falkland Islands conflict, which made the South Atlantic region appear politically unstable. The decrease in 1996/97 was due to the absence of one large ship, *Marco Polo*, which in previous seasons had carried 400-500 passengers on each of three or four cruises.

Figure 3.3 Numbers of shipborne tourists in Antarctica between 1980/81 and 1996/97, and numbers of tourists forecast to visit Antarctica between 1997/98 and 2001/2002. Sources: Enzenbacher (1993b); NSF/IAATO (1997); and IAATO (1997a).



Other factors contributed to the sharp increase in numbers during the early nineties. Two international disputes (the Falklands conflict and the Beagle Channel dispute between Chile and Argentina) were resolved to the point that the ports of Punta Arenas, Stanley and Ushuaia became more attractive to operators and clients. Governmental reorganisation in Argentina provided Ushuaia with substantial funding to increase its capacity for handling tourist ships and aircraft, making it the preferred port for most Antarctic operators. The advent of perestroika released Russian ice-strengthened vessels for refitting to passenger-carrying standards, and for charter at relatively low costs. As more people travelled south, greater publicity for Antarctic cruising was generated by advertising, word-of-mouth, television programmes and newspaper articles, attracting still more visitors to the continent.

Figure 3.3 includes also IAATO's five-year forecast for seaborne Antarctic tourism from 1997 to 2002, presented at the XXI ATCM in Christchurch in 1997 (IAATO, 1997a). The forecast is based on the premises that (a) current operators will continue at the same capacities, and (b) two new companies, Clipper Cruise Lines and Special Expeditions, will start operations. They must be interpreted with caution: as shown above, the presence of a single vessel the size of *Marco Polo*, operating several cruises, can result in a large fluctuation. Nevertheless, the forecast indicates that the industry itself expects numbers of Antarctic shipborne tourists to continue increasing during the next few years.

3.3.2.4 Environmental implications

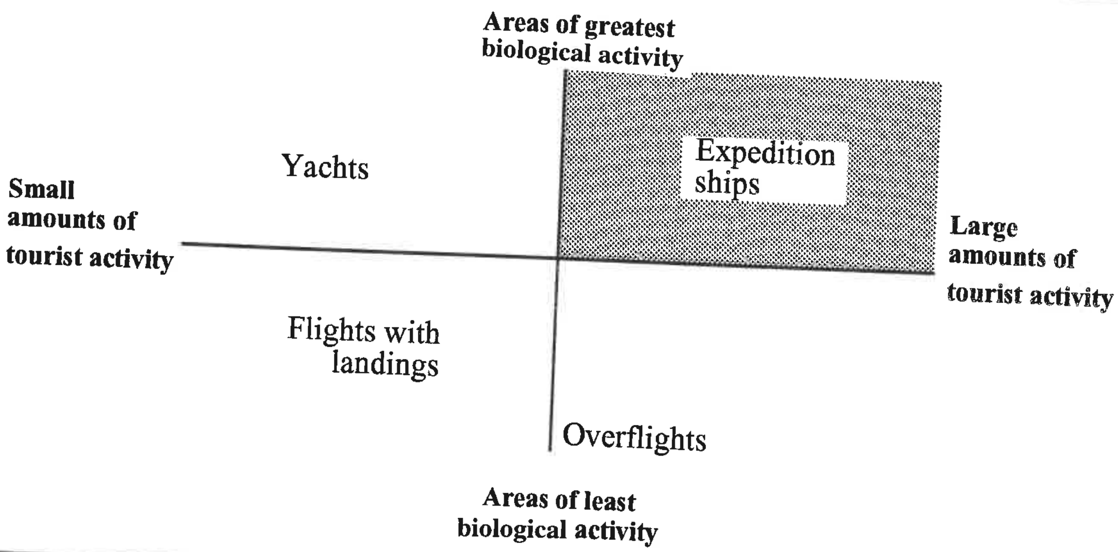
As with yacht operations, most shipborne tourist voyages visit the Maritime Antarctic primarily because of the short sea crossing (Reich, 1980; Enzenbacher, 1993b; IAATO, 1997a). Once there, they are in Antarctica's ecologically richest area. As discussed in Chapter 2, much of the biota is located on ice-free ground close to shore, at landing sites where tourists may experience it at first-hand. Concentration of activities in this region seems likely to continue into the 1997/98 season; only seven out of a total of 114 planned voyages were scheduled for departure to other areas (IAATO 1997a).

Although operators take measures to minimise environmental disturbance, for example, keeping prescribed distances from wildlife and ensuring that there is no littering (Chapter 4), the current level of activity in this region, and the likely increase, make this the most important part of the continent for investigating and monitoring effects from shipborne tourism.

3.4 Discussion and conclusions

As shown in Sections 3.2 and 3.3, Antarctic tourists have increased to unprecedented number in the last two decades. However, the divisions of Antarctic tourism, discussed in Sections 3.2 and 3.3, indicate there are four different activities occurring in different settings, and creating different environmental effects. A comparison of these forms, based on amount of activity and the environmental context in which it occurs, appears in Figure 3.4 and are discussed below.

Figure 3.4 Conceptual identification of activities in terms of potential environmental pressure. The grey shading illustrates the situation where large amounts of human activity and greatest of logical activity coincide.



1. Overflights accounted for 32% of all tourists who *saw* the Antarctic during the 1996/97 season. However, none actually came into direct contact with the continent.
2. Tourist flights which land remain very minor and represent less than 1.5% of the tourists who landed in the Antarctic in the 1996/97 season, and most of those were in areas of very low biological activity. Thus it can be argued that presently airborne tourism, despite being active in the largest geographic area of Antarctica, has relatively few adverse effects on the Antarctic environment.

3. Yachts account for approximately 2% of the total number of tourists that *landed* in the Antarctic during the 1996/97 season. Again this is a very small proportion, although certain yacht operators give especial cause for concern as they may either wilfully or unwittingly adversely affect aspects of the environment through their actions (Section 3.3.1).

4. Shipborne tourism accounts for the vast majority (96.5%) of tourists that landed during the 1996/97 season. This is the most intense level of activity which is predominantly occurring within the Maritime Antarctic.

Figure 3.4 plots the four forms of Antarctic tourism with respect to these variables. Neither form of airborne tourism occurs in regions of great biological activity, while both forms of seaborne tourism are concentrated in areas of high biological activity. The figure also illustrates that shipborne tourism, on the basis of amount and context of activity, is the form of tourism with the greatest capability to inflict damage in the Antarctic, specifically the Maritime Antarctic.

Chapter 4

Shipborne tourism, IAATO and the Protocol

4.1 Introduction

This chapter reviews the organisation of Antarctic shipborne tourism, and discusses the relationships between companies and their trade association, the International Association of Antarctica Tour Operators (IAATO). As IAATO members are committed to complying with Antarctic Treaty measures, progress towards fulfilling Protocol requirements was made during a meeting, in which the author participated, in September 1996 to prepare a framework for compiling a programmatic Initial Environmental Evaluation (IEE) for all Antarctic Peninsula shipborne tourism operations. At this meeting, matrices were prepared for ship, landing craft (Zodiac) and shore operations. They characterised actual and potential impacts. Through the matrices it became evident that disturbances from ship and Zodiac operations were relatively straightforward to identify and mitigate. However for shore operations, when tourists contact the biota directly, impacts were less tangible, more difficult to mitigate, and most likely to become increasingly significant through repeated perturbations.

Understanding the organisation behind shipborne tourism is essential both for assessing potential disturbance and ultimately for management purposes. The industry is small scale, compared with that at other destinations, including the Arctic (Stonehouse *et al.*, 1995). Although having basically similar operations, several competing companies are involved. By examining the organisation, the competition and co-operation, it is possible to identify the similarities (and differences) to be reviewed for environmental assessments of activities.

4.2 Antarctic cruise operations

Companies whose names appear on brochures for Antarctic cruises have different responsibilities for the Antarctic environment. Some (e.g. Marine Expeditions, Society Expeditions, Orient Lines) are principal operators who charter or own ships on long-term or short-term contract, and assume full responsibility for cruises to the Antarctic, among other destinations. Others (e.g. Zegrahm Expeditions, Mountain Travel-Sobek) sub-charter from principal operators for only one or two voyages per season. These charterers too assume full responsibility for their cruises. Others again (e.g. Wildwings, Life Long Learning) are agencies — essentially booking organisations that charter space on ships for groups of clients or individuals. Their principal operator takes responsibility for many aspects of the voyage.

Operators, desiring to keep their ships busy throughout the year, plan itineraries that include periods of Antarctic cruising. Usually they have an agency for direct sales, and establish a clientele loyal to their own companies. Of the many independent agencies that book passengers for Antarctic cruises, most book for cruises elsewhere. Thus for most agents and all operators, Antarctic shipborne tourism occupies about one third of the annual cycle, of which the remainder is occupied by cruising elsewhere in the world.

While every itinerary has its own challenges, polar cruises are perhaps outstanding for their dependence on vagaries of weather and ice. In partial compensation, Antarctic cruises for their first three decades were unusually free from regulation: with the exception of international requirements (e.g. SOLAS — Safety of Life at Sea, or the International Convention for the Prevention of Pollution from Ships — MARPOL) and arrangements for visiting scientific stations, cruise operators had few direct dealings with authority of any kind. This situation has changed: for the past two years operators have been preparing to conform to the requirements of the 1991 Protocol on Environmental Protection to the Antarctic Treaty. Following its coming into force in January 1998, they must adhere to the requirements of the Protocol in full.

4.2.1 Cruise operators

Table 4.1 lists 10 ~~number of~~ cruise companies involved in 1996/97 in Antarctic waters. Five are dominant in the Maritime Antarctic. In 1996/97 Marine Expeditions Incorporated had five ships in the region (*Professor Multanovskiy, Alla Tarasova, Akademik Ioffe, Akademik Vavilov,* and *Akademik Shuleykin*); Quark Expeditions Incorporated had three (*Professor Molchanov, Professor Khromov,* and *Kapitan Khlebnikov*), and Hanseatic Cruises two (*Bremen* and *Hanseatic*). Abercrombie & Kent/Explorer Shipping Corporation and Society Expeditions each operated a single ship (respectively, *Explorer* and *World Discoverer*). One other company, Southern Heritage Expeditions, operated *Akademik Shokalskiy* for three voyages in the Ross Sea region. These companies have all worked in the Antarctic for several years.

Four other companies have announced intentions to visit the Maritime Antarctic during the next five years. Orient Lines and Plantours and Partner operated during 1997/98, using large ships (respectively, *Marco Polo* and *Vista Mar*) each carrying 400 or more passengers. Although both have cruised previously in Antarctic waters, they work mainly in warmer regions. In the Antarctic they aspire toward the Lindblad pattern of operations, although the large number of passengers will make this quite difficult (Section 3.3.2.1, and Stonehouse, 1994a).

Special Expeditions and Clipper Cruise Lines, which plan to operate during 1998/99, have recently acquired ships (*Caledonian Star* and *Clipper Adventurer*, each with a capacity of 120 passengers) especially for Antarctic cruises. They too follow the Lindblad pattern of cruising, although Special Expeditions has not worked previously in Antarctic waters.

Table 4.1 List of 1996/97 shipborne tourism showing vessel operators and charters. Adapted from IAATO (1997a)

Vessel and date when began operating in Antarctic waters.	Operator (o) or Charterer (c)	Total voyages	Total passengers
Explorer (1970)	(o) Abercrombie & Kent / ESC	9	707
Professor Molchanov (1991)	(c) Aurora Expeditions	7	305
	(o) Quark Expeditions	1	27
Professor Multanovskiy (1995)	(c) Mountain Travel-Sobek	4	147
	(o) Marine Expeditions	6	227
World Discoverer (1977)	(o) Society Expeditions	8	888
	(c) Zegrahm Expeditions	1	129
Alla Tarasova (1994)	(c) Quark Expeditions	2	189
	(o) Marine Expeditions	9	759
Kapitan Khlebnikov (1992)	(c) Zegrahm Expeditions	1	88
	(o) Quark Expeditions	2	165
Professor Khromov (1994)	(o) Quark Expeditions	7	260
	(c) Adventure Network Int..	1	36
Akademik Shokalskiy (1994)	(o) Southern Heritage Exp.	3	109
Hanseatic (1993)	(o) Hanseatic Cruises	5	781
Bremen (1989)	(o) Hanseatic Cruises	1	125
	(c) Quark Expeditions	1	163
Akademik Ioffe (1993)	(o) Marine Expeditions	13	879
Akademik Vavilov (1992)	(o) Marine Expeditions	10	731
	(c) Quark Expeditions	3	224
Akademik Shuleykin (1996)	(o) Marine Expeditions	10	383
TOTAL		**104**	**7,322**

Ships may be sub-chartered either from one ship operator to another, or from a ship operator to a company that does not operate a ship of its own. For example, Quark Expeditions may have one or more ships chartered directly from owners, with extra bookings enough to justify sub-chartering a further vessel for one or two voyages from Marine Expeditions. While, Zegrahm Expeditions, who do not operate a ship, sub-charter several voyages annually from companies such as Quark Expeditions, Society Expeditions or Explorer Shipping Corporation (ESC).

4.2.2 Competition and co-operation

Companies work in competition, with each developing its own characteristics as selling points. Abercrombie & Kent/Explorer Shipping Corporation, for example, advertise *Explorer* as the original and pioneering vessel, asserting 'adventure in comfort and style'. Quark Expeditions emphasises adventure, using small Russian ships and Russian icebreakers with helicopters. Marine Expeditions advertises cheaper cruises by reducing the number of staff, providing shorter voyages and a no-frills approach that reduces costs in food and service.

Such efforts are not entirely exclusive: Abercrombie & Kent/ESC prime competitor is Hanseatic Cruises, a company which also advertises the concept of adventure in style and comfort, and both Quark and Marine Expeditions compete to run the small, but lucrative, Russian vessels.

Despite their intense competition, and the fact that none of the companies works exclusively in the south, it is remarkable that, for nearly a decade, the Antarctic tourist companies have co-operated to the extent of forming a trade association (see below) and co-ordinating activities. Arguably, this is largely because they agree on one very important point: the need to present to the public a common image of environmentally sound operations. Co-operation helps to ensure (a) common high standards of environmental concern, and (b) that companies newly entering the market pledge to conform to the same high standards, to the benefit of the industry as a whole (Stonehouse, 1992b).

Formal co-operation between companies began in 1989, when three North American companies (Mountain Travel, Society Expeditions Inc. and Travel Dynamics, Inc.) established guidelines for Antarctic tours (Splettstoesser and Folks, 1994). Oceanites, a private environmental foundation, produced a code of conduct for visitors to Antarctica (Naveen *et al.*, 1989) based on the Treaty's Recommendation VIII-9, Annex A, '*Guidelines for Visitors to the Antarctic*', adapting them to practical use in terms that could easily be understood and applied on the spot. Statements from the Treaty guidelines such as '... *avoid disturbing the wildlife*' were defined more precisely, in this instance by requiring visitors to maintain a minimum distance of five metres from all nesting birds, and to be constantly aware of the behaviour of the animals they were watching, and to keep out of their way (Section 4.3.4 below).

Co-operation has always been enhanced by the exchange of expedition staff between companies, especially guides, lecturers, Zodiac drivers and expedition leaders. Although there is no formal professional structure or training for these essential workers, some ~~of whom~~ trained with Lindblad, they help to train newcomers and instil strong loyalty to concepts of environmentally sound and safe cruising. This helps to ensure co-operation in the field, and a sense of unity — despite competition — in the higher echelons of the industry.

4.3 IAATO

In 1991, co-operation between the three companies was formalised by the establishment of the International Association of Antarctica Tour Operators (IAATO). The Association provided both a voice for the principal companies, and opportunities for other companies to join, provided they adopted environmentally sound operations. In 1991 IAATO representatives were invited to attend Antarctic Treaty Consultative Meetings as observers, and, almost simultaneously, began co-operations with the Office of Polar Programs of the National Science Foundation, the US agency responsible for environmental matters in Antarctica.

4.3.1 IAATO organisation

The majority of Antarctic tour operators and agents are based in the USA, and thus IAATO is a predominantly North American organisation, with a secretariat in New York. Its executive consists of an Executive Committee, three individuals from different companies, a 'spokesperson' unaffiliated with any company and a salaried Executive Secretary. All posts are elected at an annual meeting, to which member companies send representatives. Meetings are held at the National Science Foundation (NSF) in Arlington, Virginia, in July, in the same week as a joint meeting with NSF to review past and coming seasons. There are four levels of membership: full, provisional, probationary and associate. All require pledging to abide by the bylaws and support IAATO objectives.

IAATO describes itself as ... *a member organisation founded ... to advocate, promote and practice safe and environmentally responsible private-sector travel to the Antarctic* (IAATO, no date). These principles are enacted through the organisations by-laws (Table 4.2 and Appendix 7) and through a set of guidelines for its membership (Section 4.3.2 below).

In summary, the bylaws commit members as follows: to respect the Antarctic Treaty System and relevant international maritime environmental regulations; to co-operate with other IAATO members and IAATO activities; to respect activities of the national expeditions; to restrict landings to 100 passengers at a time and total passenger capacity to 400; and aboard any ship to employ experienced staff.

To ensure that environmental responsibilities are fulfilled, each member company nominates an environmental officer (usually an operations manager or staffing co-ordinator), who is responsible for ensuring that officers and staff on board are made aware of IAATO requirements (Section 6.2.2). Aboard the vessels the expedition leader and Captain are then responsible for ensuring that the requirements are maintained in the field.

Table 4.2 Excerpts from IAATO bylaws. Source: IAATO (no date).

(i)	Operate within the parameters of the Antarctic Treaty System and its appendages, along with MARPOL, SOLAS and similar international and national laws;
(ii)	Foster co-operation among its members, monitor IAATO programmes, including the pattern and frequency of visits to specific sites within the Antarctic and co-ordinate itineraries so that no more than 100 people are ashore at any one time in any one place and not carry more than 400 passengers per vessel;
(iii)	Co-operate with national Antarctic programmes;
(iv)	Ensure that the best qualified staff and field personnel are employed by IAATO members.

During the 1996/97 summer, all tour operators and agencies working in the Antarctic, with the exception of three minor travel agencies (Playguide, Marathon Tours & Travel and Aventyrsresor), were either IAATO members or currently applying for membership. Of the four operators planning to work there next season, only Orient Lines is not a member. Its membership was cancelled when the company declined to limit *Marco Polo* to carrying a maximum of 400 passengers (Table 4.2:ii). However, the company has agreed to operate under the principles and procedures of Antarctic Treaty Recommendation XVIII-1 (summarised in Table 4.3: see also Appendix 2), and continues to attend IAATO meetings as an observer.

Operators and agencies that are members of IAATO find it expedient to mention their membership in advertising (e.g. Abercrombie & Kent, 1997; ANI, 1997). Certain national expeditions and agencies, for example British Antarctic Survey and the National Science Foundation, allow station visits only from IAATO member vessels. The United Kingdom Antarctic Heritage Trust imposes a similar restriction on visits to its heritage site at Port Lockroy. Such restrictions are not, however, applied to tourists aboard yachts.

4.3.2 IAATO guidelines for operations

In addition to the bylaws, IAATO established a set of guidelines for operators (Stonehouse, 1992b; Splettstoesser and Folks, 1994), which were modified in 1994 to include the requirements of 1994 ATCM Recommendation XVIII-1: 'Tourism and non-Governmental Activities' (Appendix 2). Table 4.3 presents the criteria from Recommendation XVIII-1 that are relevant to tourist activities. The procedures listed in Tables 4.3, similarly to those of Table 4.2, occur in two categories, some invoking obligations to governments, others relating to field programme organisation.

In relation to governments, companies are required to inform their relevant national authority or IAATO, obtain authorisation where required, provide information to assist with contingency planning, operate in accordance with the Antarctic Treaty and the Protocol, co-operate with observers and national programmes, and report on their activities. Through compliance with Treaty requirements, these procedures also place on the companies an obligation to produce an environmental assessment of their activities if required by national law and, if appropriate, to monitor environmental impacts of activities (Table 4.2:i, Table 4.3: i - vi, and xvi - xviii).

In their field programmes, operators are required to co-operate with each other and co-ordinate activities, circulating their itineraries before the start of the voyages, and ensuring that no more than 100 people land at a site at one time. They are required to operate safely and self-sufficiently, with contingency plans for accidents and emergencies, to co-ordinate and co-operate with scientific programmes, and to ensure that the passengers are aware of the codes of conduct and the legal context of their activities (Table 4.2:ii, iii; Table 4.3:iv, vi - viii, xi-xv).

Table 4.3 Excerpts from procedures to be followed by organisers and operators, from Recommendation XVIII-1, which are incorporated into IAATO codes of conduct (see also Appendix 2).

(i)	Notify competent national authorities of appropriate Treaty Parties;
(ii)	Obtain a permit where required by national law from the competent national authority;
(iii)	Conduct an environmental assessment in accordance with procedures established by national law;
(iv)	Provide information to assist in the preparation of contingency response plans for accidents, emergencies and waste disposal;
(v)	Dispose of waste materials in accordance with Annex III and IV of the Protocol;
(vi)	Use appropriate transport and operate it safely;
(vii)	Obtain best available maps and hydrographic charts;
(viii)	Ensure that activities are fully self-sufficient;
(ix)	Co-operate fully with observers;
(x)	Be fully conversant with applicable communications;
(xi)	Design and conduct appropriate education and information programmes to ensure crew, staff and passengers are conversant with Antarctic Treaty provisions;
(xii)	Provide visitors with a copy of *Guidance for visitors to the Antarctic*;
(xiii)	Ensure visitors are supervised by sufficient number of experienced guides;
(xiv)	Obtain timely permission for station visits;
(xv)	Reconfirm station visits 24 – 72 hours prior to arrival;
(xvi)	Monitor environmental impacts of activities if appropriate;
(xvii)	Maintain a careful and complete record of their activities conducted;
(xviii)	Within three months of finishing the activity report on the conduct of the activity to the appropriate national authority.

4.3.3 IAATO guidelines for tourists

The 1991 IAATO code of conduct, applied for three seasons, was modified to comply with Recommendation XVIII-1 (Appendix 1), using direct phrases from the ATCM record. Not surprisingly, this proved less successful. The Recommendation, designed for all visitors to the Antarctic (whether station personnel on leave from station duties, private individuals on climbing expeditions, or participants of shipborne tours) and drafted for acceptability to all Antarctic Treaty Consultative Parties, appeared vague and barely relevant when issued to passengers on the point of landing for the first time on an Antarctic beach (Crosbie, *pers. obs.*).

For example, as part of the earlier guidelines, tourists received a briefing and leaflet with the message:

- *Do not disturb, harass, or interfere with the wildlife.*
- *Never touch the animals.*
- *Maintain a distance of at least 5 m from penguins, all nesting birds, and true seals and 15 m from fur seals.*
- *Give the animals right of way.*
- *Do not get between a marine mammal and the sea, nor a parent and its young. Stay outside the periphery of bird and seal rookeries.*
- *Do not feed the animals either ashore or from the ship.*
- *Keep noise to a minimum.*
- *Most Antarctic species exhibit a lack of fear that allows you to approach relatively close, however, please remember that the austral summer is a time for courting, mating, nesting, rearing young and molting. If any animal changes or stops its activities on your approach, you are too close! Be especially careful while taking photographs, since it is easy to not notice adverse reactions of animals when concentrating through the lens of a camera. Disturbing nesting birds may cause them to expose their eggs or offspring to predators or cold. Maintain a low profile since animals can be intimidated by people standing over them. The disturbance of some animals, most notably fur seals and nesting skuas, may elicit an aggressive, or even dangerous response.*

(Splettstoesser and Folks, 1994:237)

Following Recommendation XVIII-1, the equivalent message became:

A) Protect Antarctic Wildlife

Taking or harmful interference with Antarctic wildlife is prohibited except in accordance with a permit issued by a national authority.

1) Do not use aircraft, vessels, small boats, or other means of transport in ways that disturb wildlife, either at sea or on land.

2) Do not feed, touch, or handle birds or seals, or approach or photograph them in ways that cause them to alter their behaviour. Special care is needed when animals are breeding or moulting.

3) Do not damage plants, for example by walking, driving, or landing on extensive moss beds or lichen-covered scree slopes.

4) Do not use guns or explosives. Keep noise to the minimum to avoid frightening wildlife.

5) Do not bring non-native plants or animals into the Antarctic (e.g. live poultry, pet dogs and cats, house plants).

(Appendix 1: A5)

Davis's (1995a) study at Hannah Point in 1993/4 questioned the effectiveness of the initial set of IAATO guidelines finding them inadequate for the diversity of visitors and situations. Nimon (1997) was doubtful if visitors new to Antarctica and its fauna would be able to form sound judgements on whether or not they were harassing wildlife, without more detailed interpretation.

There has been no formal study of whether the later guidelines produced better or even comparable results. However, when the new version was introduced, several staff quickly perceived that informing their passengers of requirements under Recommendation XVIII-1, and issuing copies of the new guideline, were less effective than the more detailed and specific terms of the old guidelines. The author's view, based on her own experiences and discussions with experienced colleagues in the Antarctic guiding community (for example, Drennan, Hobbs, Splettstoesser, all *pers. com.*), was that the original guidelines were more relevant, easy for both guides and passengers to understand, and therefore more useful than those stated in Recommendation XVIII-1. IAATO has since made the points in Recommendation XVIII-1 into a slide presentation, which includes points from the earlier guidelines (for example the 5 m distance from wildlife). The slides are presented during a briefing session prior to the first landing when attendance of all passengers is mandatory. In addition, passengers are each given a copy of Recommendation XVIII-1 which IAATO has had translated in to the official languages of the Treaty (English, French, Russian and Spanish) and into German and Japanese to ensure passengers, crew and staff are aware of their obligations.

Johnston (1997) pointed out that regulatory strategies need monitoring and reassessment to ensure the effectiveness of codes. In this case, the major Antarctic tour operators initially, and IAATO after its formation, have endeavoured to do so and show consistent, positive commitment toward minimising environmental disturbances. As Stonehouse (1994a: 202) comments:

> *It is fortunate for the Antarctic environment that, at least from 1966, Antarctic tourism has been dominated by a strong ethic of environmental concern and conservation, based largely on the management concepts of its foremost practitioner and entrepreneur, Lars-Eric Lindblad ... That this ecologically benign pattern of management clearly appeals to most Antarctic tourists is a happy coincidence; like all the best ecotourism, it handsomely rewards the operators who practise it.*

The 'caring' pattern of operations established by the early operators, and subsequently codified and incorporated into everyday practice by IAATO, required little adaptation to conform with Treaty requirements.

4.4 IAATO's response to Protocol requirements

When the shipborne tourism industry faced responsibility for describing its activities in terms of environmental impacts (Section 2.5.2), IAATO determined that, as all its operators follow similar patterns of activities and procedures, mainly within the Maritime Antarctic, the Association would submit a single 'programmatic' Initial Environmental Evaluation — i.e. a form of IEE that would cover several voyages and companies in a specific area (the Maritime Antarctic).

To this end IAATO organised a meeting in September 1996 (in which the author participated) to develop an outline for an IEE adapted for shipborne tourist activities within the Maritime Antarctic area, excluding helicopter operations (which rarely occur in this sector). Both the concept and the programmatic IEE submitted by IAATO proved acceptable to the US Environmental Protection Agency (US-EPA), one government authority which became responsible for assessing Antarctic tourism operations during the 1996/97 season.

4.4.1 IAATO impact assessment procedures

For purposes of the framework for the IEE, operations were divided into three separate phases:

- travel (to and from the Antarctic) aboard the expedition vessel;
- travel to and from the ship to the landing site by Zodiac;
- landings: periods of several hours on shore, repeated throughout the cruise.

Assessment procedures in the form of matrices were drawn up to identify and consider possible environmental impacts from each phase (Tables 4.4 – 4.6).

The matrices serve two purposes: they identify and categorise all likely impacts, and they assess whether mitigating measures are possible and if they should be undertaken. Inevitably, matrices are subjective, generalised and simplified, taking no account of slight differences in actual practices between companies, or environmental conditions at different landing sites. Yet they do provide a method for an assessor to review possible consequences of the three defined phases of activities — one which appears to have satisfied a US administrative authority. Ultimately, the ship and voyage matrix drafted at the IAATO meeting was included in the IAATO draft IEE (1997b, Appendix XII) submitted to the US-EPA. The other two matrices were not; all three are discussed below.

The three matrices have similar structures, detailing first a range of activities, and describing the nature and duration of each. Then a list of impacts that may follow each activity, described in terms of six characteristics: nature (a description of the disturbance), result (its consequences), extent, (local or regional), duration (short, medium, long or permanent), severity (low, medium or high) and probability of occurrence (low, medium, high or 'definite', i.e. inevitable). Finally mitigation measures are considered — first, whether they are deemed possible (the answer is always 'yes'), and second, the form which they should take.

4.4.1.1 Ship and voyage operations

Table 4.4 shows the matrix covering possible effects of ship and voyage operations, including those occurring *en route* in the open ocean, in coastal waters, and during a range of normal ship operations (waste production and disposal, discharge of ballast water, maintenance work, etc.). In addition the matrices consider two special forms of impact that may arise in the course of normal operations: accidental disturbance of scientific operations, and damage to aesthetic or wilderness values of the environment.

Table 4.4: Ship and voyage operations
Matrix of potential and actual impacts

Activity / element		Impact						Possible mitigation	
Nature	Duration	Nature	Result	Extent	Duration	Severity	Probability	Yes/no	Description
Under way	November – March	Normal emissions	Light atmospheric and ocean pollution	Local	Short	Low	Definite	Y	Use low emission fuels (MARPOL)
	November – March	Accidental fuel spills	Possibly severe pollution	Possibly Regional	Medium	High	Low	Y	Spill contingency plans
Coastal cruising	November – March	Ice breaking and proximity to Local species	Disturbance of local wildlife	Local	Short	Low	Definite	Y	Apply code of conduct for operating near wildlife
Waste production	November – March	Sewage or grey water discharge	Nutrient enrichment or pollution	Local	Short	Low	Low	Y	follow MARPOL and Protocol annex III
Discharge ballast	November – March	Discharge ballast from different environment	Possible introduction of species	Local	Short	Medium	Low	Y	follow MARPOL and Protocol annex III
Maintenance work	November – March	Extra noise / waste production	Disturbance /pollution of sea water	Local	Short	Low	Medium	Y	Apply strict codes when south of 60°S
Use of lights	March	Un– natural light	Disorienting for birds	Local	Short	Low	Definite	Y	Use blinds where pracitable
Anchoring	November – March	Alteration of sea bed	Disturbance of benthos	Local	Medium	Low	Definite	Y	Use same anchor site or drift
All aspects of vessel operations	November – March	Presence	Disturbance of scientific operations	Local	Short – Long	Low - High	Low	Y	Ensure good communication between research community and ship operators

Four aspects of operations were identified as inevitably resulting in disturbance, as follows:

- *While en route* between destinations, exhaust emissions will cause limited atmospheric and oceanic pollution. Restricted to the immediate vicinity and emanating from few vessels in a relatively large area, the result will be short-term pollution of low severity.
- *Coastal cruising* may break or shift ice in proximity to wildlife. Only one ship currently used in Antarctic tourism is an icebreaker; others are likely to disturb only weak annual ice. This may accelerate the natural annual break-up, but it is judged a low environmental impact. Disturbance to birds and seals on the ice, and to whales in the water, is also deemed to be a low environmental impact.
- *Use of lights* occurs only toward the end of the season, occasionally dazzling prions and storm petrels which surround or land on vessels (Crosbie*pers. obs.*), but rarely resulting in fatalities.
- *Anchoring* disturbs the seabed over areas that vary in extent at different sites. This damage has not been investigated, but is likely to be low — far less than that caused by iceberg scouring or normal sediment deposition.

IAATO considers all these to have less than minor or transitory effects, as they result in only short-term, localised physical disturbances, from which the natural environment can recover quickly .

Maintenance work to vessels in Antarctic waters is categorised as moderately likely, and probably resulting in extra waste and noise. Minimally, replacement of a damaged porthole could result in flakes of paint or sealant dropping into the sea. More seriously, damage to a bowthruster could result in a slight oil discharge. When this happened in 1996/97, because of danger of further leakage the ship left the Treaty area and repairs were made elsewhere. For more crippling damage, repairs would need to be carried out immediately, possibly resulting in more serious consequences on the local environment.

Two activities were identified as having low probability of occurrence but possible impacts of medium to high severity:

1. *Ballast discharge* could disturb scientific operations or lead to introduction of alien species. This form of discharge seldom becomes necessary in Antarctic waters. IAATO members agree that ships under their charter will not discharge ballast in the Treaty area except in emergency (IAATO, 1997c).
2. *A major accidental oil spill* would probably result in immediate and severe local damage to the environment. In accordance with both MARPOL and Annex III of the Protocol, vessel operators have fuel spill contingency plans and carry equipment for immediate containment of spills. Along vulnerable coastlines elsewhere in the world, these would be assisted by specific coast contingency plans for dealing with oil spills, for which no provision is made in the Antarctic Treaty System.

On the basis of incidents to date, ballast discharge and oil spills are both unlikely occurrences. Discharge of dirty ballast water or flushing from tank cleansing operations are probable causes of otherwise unexplained oil slicks and oiled birds that occurred from time to time along the shores of South Georgia and the South Shetland Islands during the 1950s and early '60s, probably due to whaling and fishing operations (Stonehouse, *pers. com.*). The author has been unable to trace any recent reports suggesting similar incidents.

In the history of Antarctic shipborne tourism the author has identified only six incidents of grounding involving ships carrying tourists: *Magga Dan* in 1968; *Lindblad Explorer* in 1972 and 1980 (Reich, 1980); the *Southern Quest*, 1986 (Mears and Swan, 1987); *Bahía Paraíso* in 1989 (Manheim, 1990); *Professor Multanovskiy* in 1995; *Professor Khromov* in 1997 (Crosbie, *pers. obs.*). From these incidents, only *Bahia Paraiso* released significant amounts of oil (Section 2.3.1). Although carrying civilian tourist passengers, this was an Argentine naval vessel, ~~not subject to inspection or scrutiny under the Treaty~~, nor a designated passenger ship, and with no affinities to the tourist industry. Given that over 530 properly constituted tourist voyages have taken place since 1989/90, the industry has an exemplary safety record.

From its matrix-based assessment of ship and voyage operations, IAATO drew the following conclusions:

- In normal operations, expedition vessels have only a less than minor or transitory impact on the environment.
- Only in the case of an accident is there the potential for ship operations to result in impacts that are more than minor or transitory. The probability of accidents is low, and mitigation measures are possible.

4.4.1.2 Small boat operations

Table 4.5 presents the matrix for activities and possible impacts from small boat (almost exclusively Zodiac) operations. All are classified as local, their severity low (with the exception of possible disturbance of scientific operations), and all durations are of short or medium term.

The impacts may be divided into two categories, pollution and disturbance. Two situations were listed where impacts are definite:

- Starting and running outboard engines usually results in slight fuel spills, extremely limited in volume and area. Normal operations are often accompanied by slight, visible oil emissions, that rarely extend beyond half a metre behind the engine. Proper maintenance minimises these leaks. Accidental spillage of oil or petrol is possible, but Zodiac tanks contain, at most, 50 litres of fuel. Such accidents can be avoided through careful operations and assessments of conditions, based on drivers' capabilities. The history of the industry in Antarctica reveals no records of fatal or environmentally damaging Zodiac accidents.

Table 4.5: Small boat operations: Matrix of potential and actual impacts

Activity / element		Impact						Possible mitigation	
Nature	**Duration**	**Nature**	**Result**	**Extent**	**Duration**	**Severity**	**Probability**	**Yes/no**	**Description**
Preparation and fuelling of boat	November – March 1 hr	Noise / potential spills	Possible pollution	Local	Short	Low	Medium	Y	Apply strict operational practices
Starting and running engine	November – March 1 - 3 hrs	Slight spills	Slight pollution from normal emissions	Local	Short	Low	Definite	Y	Maintain engines Use unleaded fuel
	November – March 1 - 3 hrs	Accidental spills	Possible slight pollution	Local	Short	Low	Low	Y	Carry spill kits Use unleaded fuel
Coastal cruising	November – March 1 - 3 hrs	Noise / turbulence	Disturbance of local populations	Local	Short	Medium	Medium	Y	Apply strict codes of practice near wildlife
	November – March 1 - 3 hrs	Accidental littering	Pollution	Local	Medium	Medium	Low	Y	Apply strict codes of conduct
Shore landings	November – March 1 – 3 hrs	Dense traffic in limited inter tidal zone	Disturbance of species in littoral zone	Local	Medium	Low	Definite	Y	Endeavour to use same specific landing zone / strict codes and careful scouting
Anchoring	November – March 1 – 2 hrs	Alteration of sea bed	Disturbance of benthos	Local	Medium	Low	Medium	Y	Secure boats to gangway or use shore anchors
All aspects of small boat operations	November – March	Noise / turbulence	Disturbance of scientific operations	Local	Short – Long	Low - High	Low	Y	Ensure good communication between research community and ship operators

- Movement of boats close inshore may disturb local biota, for example inter-tidal invertebrate populations: such shallow, sheltered natural harbours as Dorian Bay are home to a wealth of isopods, small bivalves and other marine invertebrates (Crosbie, *pers. obs.*). However, this life is subject to abrasion by fast ice, beside which incursions of Zodiac propellers and their potential impact are minimal.

Disturbance of bird and other wildlife populations from coastal cruising was given a rating of medium probability, largely because small boats can, and do, get close to seabird colonies ashore or marine mammals on ice floes. Nevertheless, Zodiacs and the passengers within them are under the close control of their driver, and this form of disturbance is easily mitigated by operational procedures.

All other disturbances were deemed of low probability, with only accidental littering or potential disruption of scientific operations resulting in possible impacts that were of medium or high severity. Again these disturbances can be easily mitigated, and are deemed minor or transitory. From this matrix IAATO concluded that:

- possible impacts from pollution arising from small boats is minor because of the small quantity of fuel carried;
- local disturbance to inter-tidal fauna is limited to a few sites, and tide-dependent. Impacts may be reduced by concentrating disturbance at one recognised landing point, preferably at high tide;
- disturbance to wildlife may occur if boats approach seabirds or seals too closely. This can be avoided through observance of the codes of conduct for small boat operations.

4.4.1.3 Shore operations

Table 4.6 presents a matrix developed from the IAATO matrix for activities and possible impacts ashore, when passengers leave the confines of the Zodiac and come into direct contact with the land.

Table 4.6: Shore operations:
Matrix of potential and actual impacts

Activity / element		Impact						Possible mitigation	
Nature	Duration	Nature	Result	Extent	Duration	Severity	Probability	Yes/no	Description
Landing of passengers at individual sites	November – March 1 – 3 hrs	Direct perturbation of the site's ecosystem	Compromise physical and biological environment possibly affect regeneration of colonies	Local	Short - Long	Low - High	Definite	Y	Strict control and group awareness. Knowledge of relevant scientific results and recommendations
Visits to locations of special significance	November – March 1 - 3 hrs	Possible removal or degradation components	Potentially compromise scientific or heritage site	Local	Permanent	High	Low	Y	Strict control and reminders not to remove anything.
	November – March 1 - 3 hrs	Visiting site of value to science (including stations)	Compromise the scientific value and integrity of the site	Local	Short - Long	Medium	Medium	Y	Strict group control and good communications with scientific community
Movement between sites	November – March	Spread of pathogens	Threaten local species;affect scientific research	Local	Permanent	High	Medium	Y	Strict control and cleaning of equipment between landings
Movement between ecosystems	November – March	Introduction of alien species	Competition to endemic species – could affect regeneration	Local	Short	High	Medium	Y	Strict control and cleaning of equipment between landings
All aspects of shore operations	November – March	Leaving of graffiti or litter	As above	Local	Short – Permanent	Medium	Low	Y	Strict control and group management

Evaluating impacts for shore operations is more complex than for shipborne or small-boat operations. Although the activity of putting passengers ashore is much the same for every landing, the landing areas differ substantially in sensitivity. At some sites it is possible to land 100 passengers without disturbing historical artefacts, scientific research, vegetation or wildlife in any measurable way. At others, the presence of a historic relic or vulnerable biota close to the landing point makes it almost impossible for passengers to land without causing some disturbance. At others again, at particular times of the season (for example when juvenile penguins crowd the shoreline usually during the moulting period shown in Figure 4.1) landing is impossible without compromising IAATO or Treaty guidelines relating to disturbance.

In proffering 'programmatic' IEEs for consideration by the US-EPA, IAATO emphasised the uniformity of its activities throughout the industry, and as far as possible generalised their consequences. This proved valid for dealing with ship, voyage and small boat operations, and indeed when considering the actual operations of landing passengers. However, they found no simple way to accommodate the varied nature, qualities and vulnerability of the sites. The only possible response was to generalise both activities and effects. Thus the matrix in Table 4.6, developed from the matrix written in the meeting provides a list of impacts that, in IAATO's view, may occur from landing groups of up to 100 tourists at a time, at a 'generalised' Maritime Antarctic site.

The shore activities matrix lists possible impacts under three broad headings:

- 'cultural or scientific impacts' would arise, for example, if passengers or staff removed the harpoon heads from the abandoned station at Whalers Bay, or if they disembarked at a SPA and disturbed research projects. Mitigation is relatively simple, based on strict adherence to codes of conduct (Table 4.3, xi-xii) with communication between the scientific community, national governments and tour operators. To this end, each season IAATO sends a revised list of all Antarctic protected areas to tour companies, for locations to be marked on charts, and tour staff made aware that landings should not be made there.

Figure 4.1 This scene at Cuverville Island is typical for landing sites in February as the penguins come ashore to moult. It would be difficult to land tourists here without moving the birds

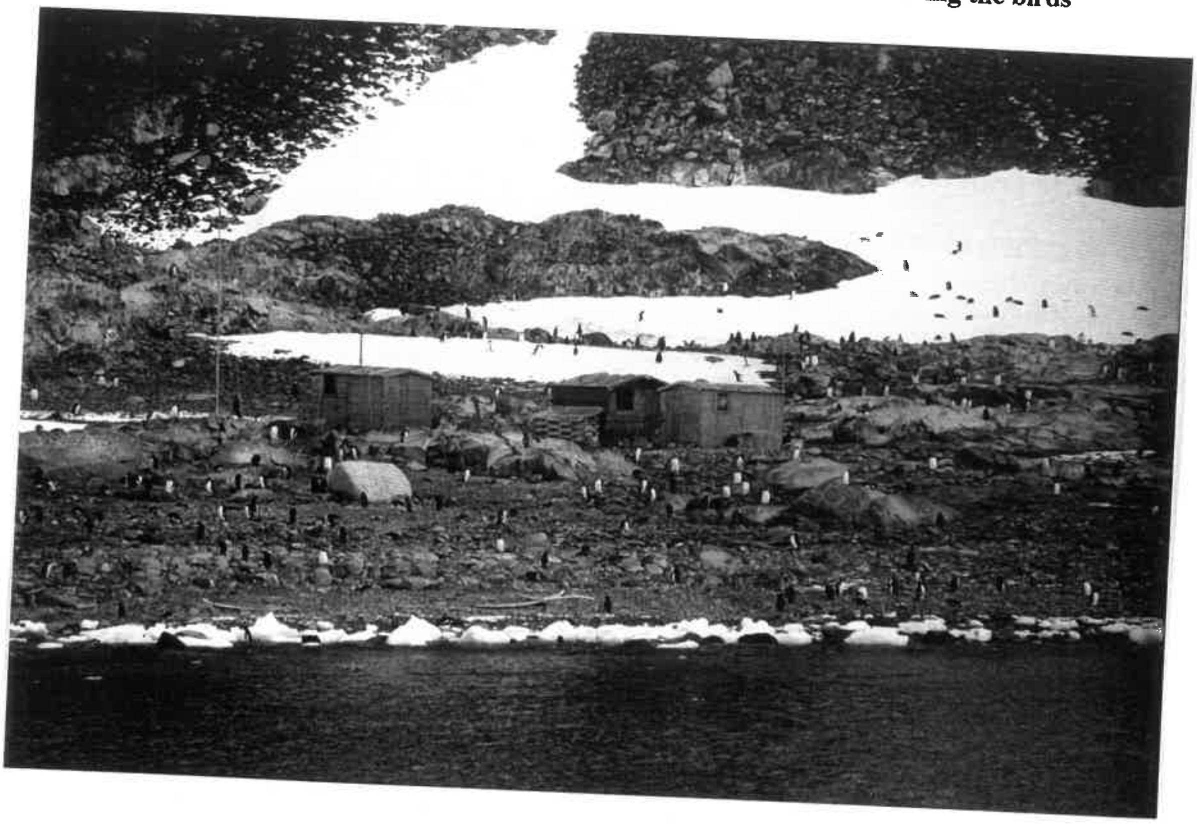
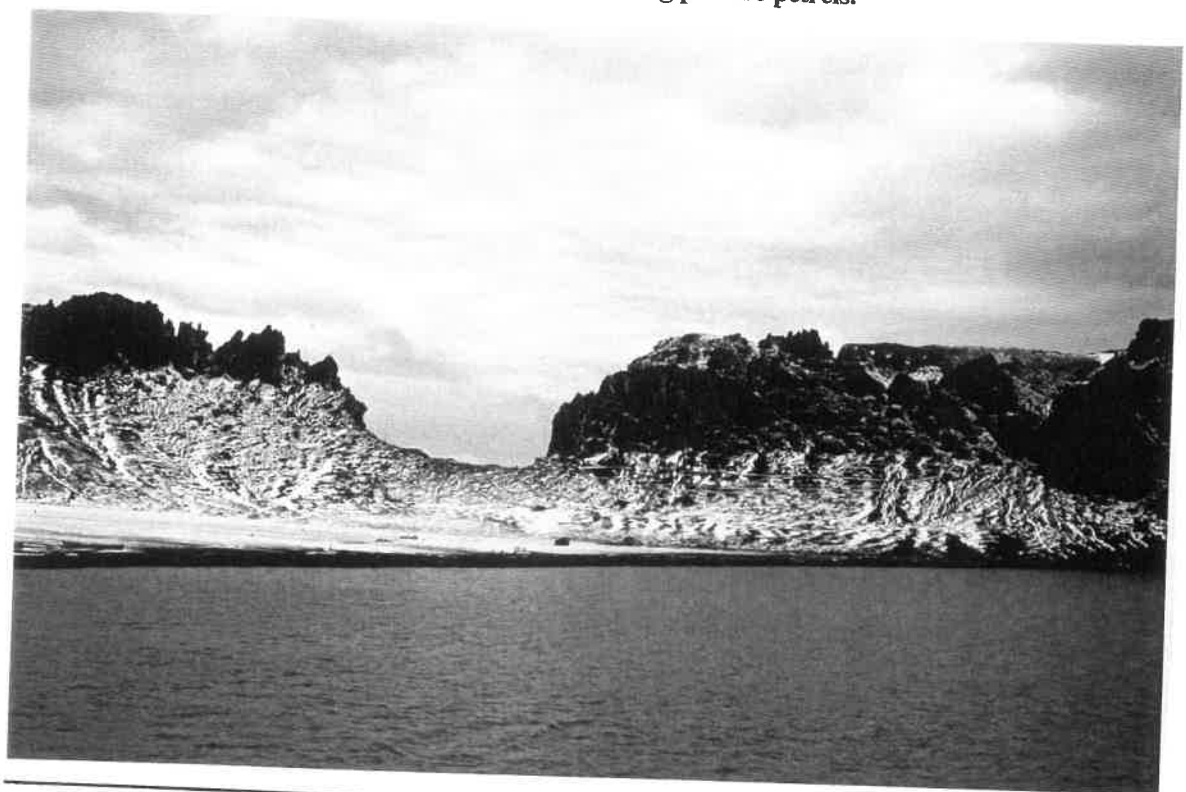


Figure 4.2 Neptune's Window, Whalers Bay. The snow fall has emphasised the paths that contour the slope to the right of the 'window' towards the nesting pintado petrels.



- 'physical impacts' include littering, graffiti, removing fossils or minerals (even souvenir pebbles); these forbidden activities can be mitigated by adherence to codes of conduct. Creating obvious tracks by constant use, another physical impact, reduces the aesthetic qualities of a site, and may affect local hydrology. Such footpaths have developed at several popular sites, for example, on fine gravel slopes beneath Neptune's Window at Whalers Bay, Deception Island (Crosbie, *pers. obs.* Figure 4.2), and across fine scoria slopes on Penguin Island (Crosbie, *pers. obs.*).
- 'ecological impacts' include disturbance to vegetation, and to bird colonies which could affect breeding success, recruitment of new breeders, and predator/prey relationships. Others considered included spread of pathogens and introduction of non-native species. Clearly the likelihood of these occurring depends on which ecological factors are present at a particular site, and in what abundance. For mitigation, the matrix draws attention to IAATO codes of conduct.

The matrix takes no cognisance of individual differences between sites, nor does it consider cumulative effects of multiple visits to sites. IAATO seeks to ensure, through its codes of conduct, that ships generally keep out of each others' way, and that no two visit a site simultaneously. It does not attempt to control total numbers of visits made to individual sites (for a rare exception see Section 6.2.1). Nevertheless, many of the impacts and results considered under 'ecological impacts' are likely to be intensified by multiple visits, and some sites are visited almost daily in the high season, factors which could be significant for their ecological integrity.

Since the implications of multiple visits are unknown, no measures in mitigation have been instigated by tour operators, or by Protocol regulations, other than a general request to monitor.

Generalising for the shore-operations matrix has inevitably led to generalised conclusions. The action of landing passengers, described as a direct perturbation of the site's ecosystem, is judged a 'definite' compromise of the physical and biological environment, at levels ranging from low to high, with mitigation provided by a general imposition of strict codes of conduct, and 'knowledge of relevant scientific results and recommendations' (for comment on this point see Chapter 7).

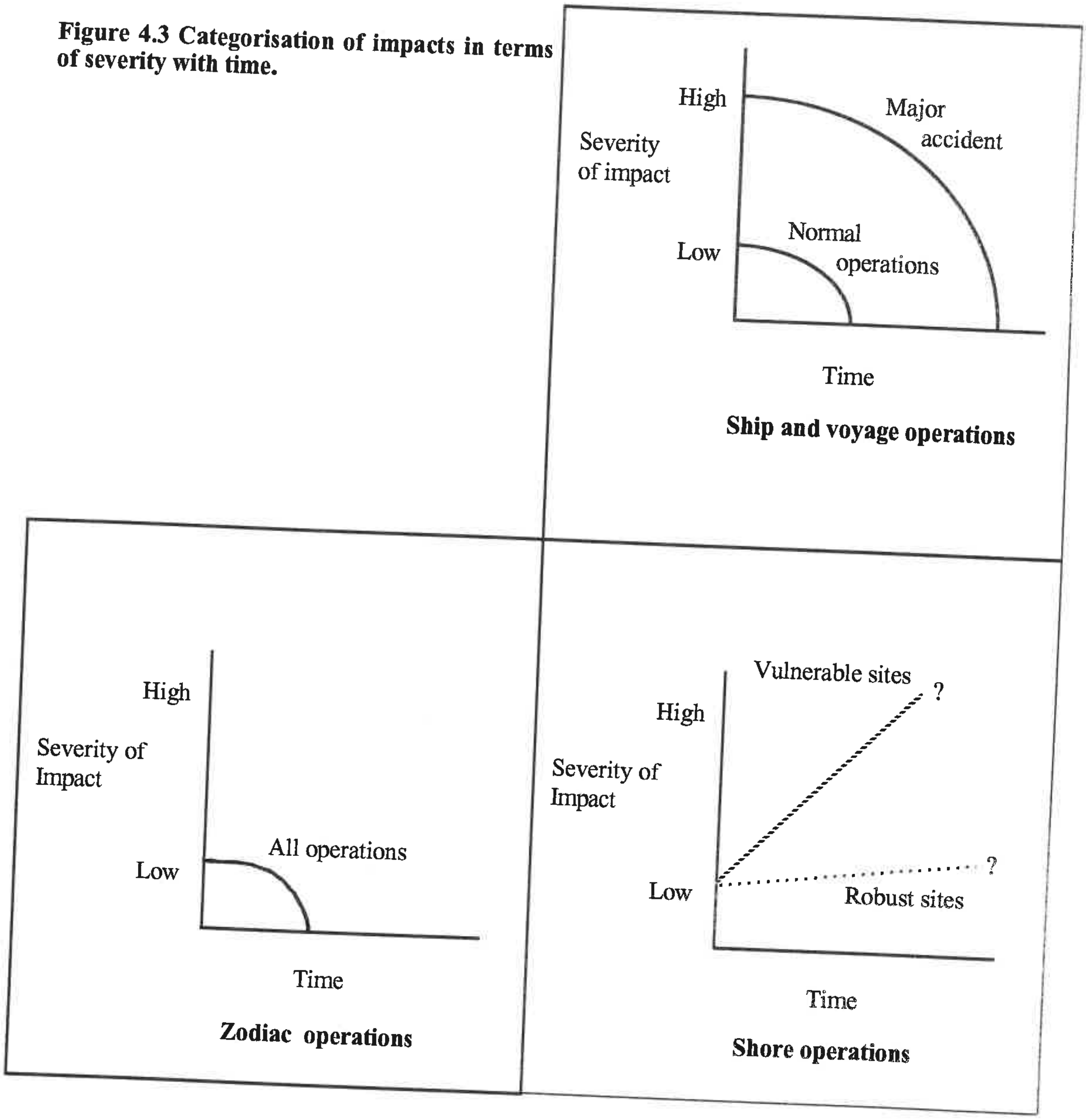
Three possible impacts considered to be of medium probability were disturbances created through visits to scientific sites (including stations), spread of pathogens between sites, and the introduction of alien species. The first is readily minimised by communication between scientific communities and tour operators. The last two were considered of possibly high severity, as they could directly affect endemic populations. The mitigation, strict control and cleaning of equipment and clothing between landings, is unlikely, at current evidence, to be practised with rigour sufficient to be effective.

Impacts considered to be of low probability — removal or degradation of historic artefacts, littering or graffiti at individual sites, may all be dealt with through effective management of visitor groups. The incidence of these is low. Many removable artefacts, for example harpoon heads, remain untouched at Whalers Bay after many thousands of visits, as do the fossils at Hannah Point (see Figure 6.3). There are no recorded instances of graffiti by tourists, and only very few of littering, at even the most popular landing sites (Crosbie, *pers. obs.*).

4.4.1.4 Operations in time

Figure 4.3 compares the three phases of operation by potential for cumulative impact. For this purpose, impacts are categorised as those resulting from accidents or emergencies and those resulting from normal operating procedures. The former, whether slight or major when they occur, give rise to effects that in time diminish in severity. The latter, although slight or even negligible as single events, may from repetition lead to results of increasing severity.

Figure 4.3 Categorisation of impacts in terms of severity with time.



There is the possibility for ship operations to result in major disasters in the case of an accident. However, the probability of this occurring is very low and, to a certain extent, mitigation measures have been put in place. In normal operations, expedition vessels have only few effects on the environments which they transit.

Zodiac operations are likely to result only in less than minor or transitory, or just minor and transitory, impacts.

Although there is insufficient knowledge regarding the implications of repeated disturbances at sites, shore operations, may result in an increasingly significant impact as a result of repeated small disturbances (De Poorter and Dalziell, 1997). The matrix of shore operations is characterised by greater ambiguity than the assessments of other activities, with no ability to distinguish between sites of varying vulnerability. This is due to lack of information on how visits may affect Antarctic biota in general or in specific locations. As a result it is not yet possible to establish what the consequences of repeated perturbations will be on an individual site, or to design appropriate mitigation measures.

4.5 Discussion and conclusions

It was perhaps remarkable that the Antarctic shipborne tourist industry, expanding during the late 1980s and early 1990s, with the inevitable competition between its companies, confined itself to the 'Lindblad pattern' of cruising — the relatively narrow range of operations described in Section 3.3.2.1.

More remarkably, competition did not inhibit the operators from finding, and agreeing and co-operation in the environmentally-sensitive ethics and practices of its founder, Lars-Eric Lindblad. Discovery of this common cause — a good selling point for the predominantly prosperous US clientele that they were all seeking to attract — gave rise first to co-operation over producing a code of conduct for the industry and guidance for clients, and later to the formation of IAATO, the industry's trade association.

The traditionally small number of operators and agents remains, each showing individual character, but all performing in much the same limited way in Antarctica. IAATO's executive continues to represent the industry in dealings at national and international levels. When Antarctic shipborne tourism became subject to authorisation under the Antarctic Treaty System, IAATO undertook to present the case of US operators (who outnumber all others in the organisation, as they do in activities in Antarctica) to the US designated authority.

So uniform are practices within the industry that IAATO was able to present a case for fulfiling the statutory requirements for Initial Environmental Evaluation by a 'programmatic IEE', summarising all the industry's activities in the Maritime Antarctic region under three headings: 'Ship and voyage operations', 'Small boat operations' and 'Shore operations'.

Through assessments of the three phases of activity in matrix form, it became apparent that the first two sets of operations were relatively straightforward to describe and assess, and for mitigation measures to be prescribed where necessary. Shore operations proved more complex: landing passengers is a simple and unvarying activity, but the sites themselves vary widely in their sensitivity. As IAATO and its members recognised, a matrix based on a 'generalised' site is not very realistic. Recent Draft IEEs submitted by both IAATO (1997b) and Landau (1997) included only matrices for ship and voyage operations, with small boat operations included, but none for operations ashore.

In these drafts, consideration of effects on wildlife from landings were left without conclusions, covered only by vague phrases — for example that disturbances from landings ... *could result in a change of behaviour or significant decline in breeding populations, although this is unknown*... (IAATO, 1997b:34). Thus IAATO's very practical approach to the problem of IEEs, while adequate to cover two aspects of its operations, is inadequate for the third. The operators have to admit that they cannot yet provide a complete account of the consequences of their landings.

Clearly, therefore, if the principles of the Protocol are to be upheld, matrices of impacts of the kind proposed by IAATO, although a useful start, cannot deal adequately with shore operations at sites that range widely in vulnerability. It follows a *fortiori* that neither can any other simple form of generalised IEE that does not take into account these variations, cannot describe accurately the different impacts arising from similar activities at different sites, or take into account the all-important issue of consequences of cumulative impacts.

Chapter 5
Patterns in landing site use

5.1 Introduction

The amount of use to which individual landing sites are subject, including the seasonal and annual use, can be derived from data collected at the end of each season by the National Science Foundation (NSF) and IAATO since 1989/90.

For this analysis, 128 landing sites are identified in the Maritime Antarctic, clustered into five geographic areas, and distinguishable in environmental characteristics and amount of use by the shipborne tourist industry. Five variables —number of passengers, ships, voyages, sites used and landings made — for the eight seasons represented are tabulated for analysis, presented graphically and discussed as a result of the author's experiences.

Evidence of the increasing numbers of ships, voyages and passengers, in varying ratios is presented. There have been fewer passengers on each voyage, but more voyages for each vessel. This corresponds to the increasing use of smaller ships on shorter voyages in order to cater for the cheaper end of the market. Yet the number of landings per voyage has remained the same, suggesting that, to meet passengers' expectations of a wide range of environmental and cultural experiences, a minimum number of sites needs to be visited each voyage.

5.2 NSF/IAATO landing site data

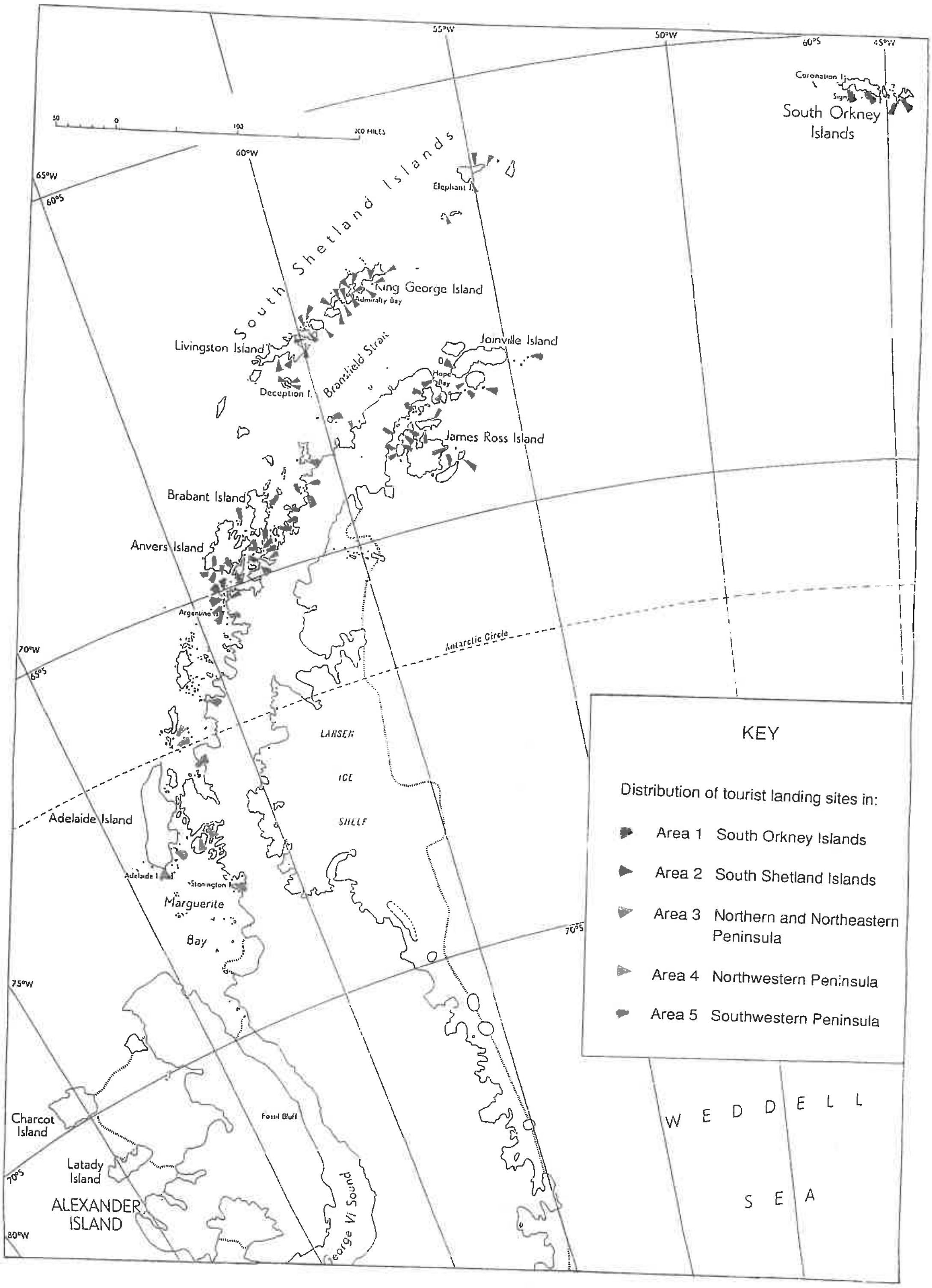
Basic information on Antarctic cruises (numbers of vessel, operators, voyages, sites used and landings made) from 1989/90 onward has been compiled by IAATO, and passed to the National Science Foundation for collation and discussion at annual joint IAATO/NSF meetings (Section 3.3.2). As noted in that section, the data contain a number of discrepancies. Between 1989/90 and 1993/94 actual numbers of all parameters underestimates by approximately 15% since not all vessels were US-operated or chartered by IAATO members. Later reporting has been more complete and reliable, with all operators reporting to IAATO either directly or through their governments.

Returns for 1996/97 provide a cumulative listing of 189 passenger landing sites for the Antarctic and South Georgia. For the Maritime Antarctic alone, eliminating unidentifiable sites and duplicated names, there remain 128 sites, all identifiable by name and geographical co-ordinates. These have been authenticated from either *Geographic Names of the Antarctic* (Alberts, 1995) or *Place names in the British Antarctic Territory* (Hattersley-Smith, 1991) — two authoritative sources that are in fundamental agreement. Together with ~~the year of first visit (if known) and~~ the cumulative number of visits since 1989/90, the sites are listed in Appendix 5, and plotted on Map 5.1.

5.3 Distribution of landing sites

Throughout the Maritime Antarctic, the mainland and many of the islands are dominated by permanent ice caps and glaciers. Coasts consist of ice shelves or glaciers alternating with ice-free bays, headlands and peninsulas. Ice-free areas accommodate most of the vegetation and wildlife, and include the sites which are used for landing groups of tourists.

Map 5.1 Distribution of tourist landing sites in the Maritime Antarctic



The Maritime Antarctic landing sites are here grouped into five sub-regions: the South Orkney Islands; the South Shetland Islands; Northwest Antarctic Peninsula (south to the Argentine Islands); Northeast Antarctic Peninsula (including Antarctic Sound, Danger Islands and James Ross Island); and Southwest Antarctic Peninsula (Argentine Islands south to Marguerite Bay). Each sub-region has its own characteristics, and varies in popularity as a tourist destination (Table 5.1).

Table 5.1 Number of tourists visiting sites in the five sub-regions 1989/90 to 1996/97. Source: Appendix 5.

Sub-region	Number of sites	Maximum number of visits to single site between 1989/90 and 1996/97	Mean number of visits to all sites between 1989/90 and 1996/97
South Orkney Islands	5	35	12.4 ± 14.8 SD
South Shetland Islands	42	296	40.76 ± 69.3 SD
Northwest Peninsula	44	251	36.3 ± 64 SD
Southwest Peninsula	12	9	3.25 ± 3 SD
Northeast Peninsula	25	151	12.56 ±31.8 SD

From Table 5.1 it becomes apparent that the amount of tourist activity varies widely between the sub-regions. Thus, the South Shetland Islands and the Northwest Peninsula sub-region contain the greatest number of landing sites, and are also subject to the highest number of visits, both variables indicating the accessibility and attractiveness of these sub-regions.

5.3.1 South Orkney Islands

The South Orkney Islands, an archipelago 600 km northeast of Antarctic Peninsula, comprise four main islands (Coronation, Laurie, Powell and Signy island) and several smaller islands and islets. Mountainous and largely ice-capped, they cover an area of approximately 622 km^2 (Headland, 1998). Most flat, ice-free areas are on the southern shores: the north coasts are dominated by cliffs and glacier faces, with few landings for wildlife or human visitors (Watson, 1975).

Climatological records have been kept from 1903 at Orcadas, an Argentine meteorological station on Laurie Island (a station established originally by the Scottish National Antarctic Expedition 1902-04), and from 1947 at Signy, a British station on Signy Island. Because of cold air and sea currents from the Weddell Sea, the islands are unusually cold for their latitude, cooler than the neighbouring South Shetland Islands: the mean annual temperature at Signy is -4°C. They are usually free of sea ice from January to March, when mean temperatures ashore normally rise a few degrees Celsius above freezing point (Watson, 1975).

Four species of penguins and 12 other species of seabirds breed on the islands (Watson, 1975; Croxall *et al.*, 1981).The cooler temperatures appear to influence species abundance and diversity. For instance, although there are four species of penguins which breed here, according to Woehler (1993) there are three times as many Adélie penguins found breeding in the South Orkney Islands than in the South Shetland Islands (198,000 pairs to 59,700 pairs) but only a fraction of the macaroni penguin population (50 pairs to 13,253 pairs). Antarctic fur seals, Weddell, elephant, crabeater and leopard seals are all plentiful, and humpback and minke whales are occasionally sighted offshore. There are thick patches of vegetation, mainly lichens and mosses, at elevations up to 200 metres (Smith, 1972).

The South Orkneys are usually visited only by tour ships enroute between the Antarctic Peninsula and South Georgia, and rarely for more than half a day. The sites most often used are Shingle Cove, Coronation Island (near Signy Station), and Orcadas on Laurie Island.

5.3.2 South Shetland Islands

This is an island chain about 540 km long, located 770 km south of Cape Horn and 160 km northwest of the Antarctic Peninsula. Except for Islas Diego Ramirez, they are the closest southern landfall to South America. The archipelago, extending from the Elephant Island group south to Smith Island, includes 11 large islands (Elephant, Clarence, King George, Nelson, Robert, Greenwich, Livingston, Snow, Deception, Low and Smith islands) and many smaller islands and islets, particularly along the northwestern shores. The main islands are mountainous and predominantly ice-capped, although with many ice-free headlands and bays (Watson, 1975).

Warm moist winds from the north and west give the South Shetlands a slightly warmer and damper climate than the South Orkneys. The mean annual temperature of stations on King George Island, central to the group, is approximately –2.7°C. The islands are free of sea ice from November to March. Accessibility makes these islands popular with national expeditions: some 17 scientific stations have been established there at different times (Ferrigno, 1996).

The South Shetlands have five species of penguins (although rockhopper penguins have been recorded breeding only once) and a further 13 species of other sea birds (Watson, 1975; Croxall and Kirkwood, 1979; Croxall *et al.,* 1984; Woehler, 1993). Antarctic fur, elephant, Weddell, crabeater and leopard seals are plentiful, and large numbers of humpback, minke and killer whales feed locally during the second half of summer. Vegetation is slightly more abundant than on the South Orkneys, including extensive moss beds on coastal flats (Smith, 1997).

These islands make a popular first landfall for tour ships after crossing The Drake Passage. That nearly one third of all Maritime Antarctic tourist landing sites are located on them. Table 5.1 confirms this regions popularity. There are also strong elements of historic interest (notably relics of sealing and whaling), several active research stations, and the unusual special attractions of Deception Island, which include bathing in geothermally-heated sea water.

5.3.3 Northwest Antarctic Peninsula

Northwestern Antarctic Peninsula extends approximately 400 km from the western limit of Antarctic Sound, southwards to the Argentine Islands in 65°15'S. Mountainous, with peaks up to 3,500 metres and a prominent ice plateau. The Antarctic Peninsula has a northwest coast deeply indented with fjords and bays, and fringed by islands, with sheltered waters and landings possible at many points. This sub-region offers some of Antarctica's most spectacular scenery of mountains, tumbling glaciers and ice cliffs.

The mean annual temperature at Melchior, representing the middle of the sub-region, is about –3.5°C, with mean monthly temperatures close to, or above, 0°C between December and March. Pack-ice encloses the shore for about seven months annually, leaving many landing sites ice-free for a long summer. There are currently six winter and several summer research stations.

The three species of pygoscelid penguins and 11 other species of seabirds breed in the sub-region (Watson, 1975; Croxall *et al.*, 1984; Poncet and Poncet, 1987) . Non-breeding fur seals and elephant seals come ashore to moult in late summer: Weddell, crabeater and leopard seals are frequently sighted. Large numbers of humpback, minke and killer whales occur during the latter half of summer (Crosbie, *pers obs.*).

In numbers of tourist landing sites, this is the most visited sub-region (Table 5.1), primarily because of the spectacular setting for the other natural attractions. Like the South Shetlands, it is an area rich in the history of expeditions and whaling, offering many natural harbours and a wide choice of landings.

5.3.4 Northeast Antarctic Peninsula

The Northeast Peninsula sub-region extends southward from the western end of Antarctic Sound, including D'Urville, Joinville, Bransfield and Dundee islands to the southern end of James Ross Island at 64°12'S. Isolated from warm maritime westerlies by the mountains of the Peninsula, and chilled by shifting pack-ice of the Weddell Sea gyre, it is drier and colder than the western flank, with more ice-free ground. In some ways it offers a glimpse of conditions in ice-free areas much further south in continental Antarctica (Section 1.4.1).

Temperatures are generally lower than in equivalent latitudes of the western shore. Hope Bay has a mean annual temperature of –6 °C, with fast ice and pack-ice regularly enclosing it well into the middle of the summer (Antarctic Pilot, 1974; Crosbie *pers. obs.*). The area has only three winter scientific stations, Esperanza and Petrél in Antarctic Sound, and Marambio on Seymour Island.

This is an area of particular geological interest, with fossils and distinct minerals at many locations. Vegetation is sparser (Smith, 1996a) and wildlife less varied and abundant than on the western side , with only two species of penguins and eight of other seabirds (Watson, 1975; Croxall *et al.*, 1984).

Fewer ships visit this part of the Peninsula because of the late break-up of sea ice, and the time required to reach it. Visits have recently increased: for example, of the 20 sites in this sub-region which have been visited (Table 5.1), only seven were visited before 1995/96, and only seven have been visited more than twice (Appendix 5). This is a direct consequence of the recent break-up of the Prince Gustav Ice Shelf, which has made the sub-region more accessible to ships in the last two seasons (Crosbie and Splettstoesser, 1997).

5.3.5 Southwest Antarctic Peninsula

This includes the Peninsula coast extending south from the Argentine Islands to the northern coast of Alexander Island in 69°S. The largest of the five sub-regions, with topography similar to the Northwest Peninsula, it is considerably colder: mean annual temperature at Stonington Island is -7.5°C, with mean temperatures of the warmest months below 0°C. Pack-ice and fast-ice rarely break up before late December in Crystal Sound, even later and less reliably in Marguerite Bay (Antarctic Pilot, 1974).

Wildlife is similar to that of the Northwest peninsula but with only three penguin and nine other seabird species (Croxall *et al.*, 1984; Poncet and Poncet, 1987; Woehler, 1993). Fur and elephant seals occur in small numbers at the northern end of the sub-region, while crabeater, Weddell and leopard seals are found throughout. Killer whales and minkes are seen in this area, although humpbacks are less common. Vegetation becomes sparser with the higher latitudes (Smith, 1996). This is the least popular sub-region. There are a few known, easily-accessible landing sites north of Adelaide Island, and a few in Marguerite Bay, notably the refurbished base of the US Antarctic Service Expedition 1939–41 and adjacent Falklands Islands Dependency station on Stonington Island. The main attraction for tourists is the opportunity to cross the Antarctic Circle, a time-consuming exercise, highly dependent on ice and weather conditions, with little to see along the way.

5.4 Landing operations

NSF/IAATO data on landing sites provide information on how often individual sites are used, and how usage varies within and between seasons.

5.4 .1 Landing sites: frequency of use

Among the 128 landing sites listed in Appendix 5, the number of visits vary widely. As Table 5.2 shows, during the eight years analysed, approximately one-third of the sites were visited only once, while a very small proportion of the sites (5%) were visited over 200 times each.

The popularity of each individual site varies with the number or quality of features located there, and the ease of access for ships and Zodiacs. Although some sites seem always to remain popular (e.g. Whalers Bay, Deception Island, for its derelict whaling station and steaming beaches), the popularity of others changes from season to season. For example, since Port Lockroy was recently refurbished by the United Kingdom Antarctic Heritage Trust (UKAHT) in 1995/96, numbers of visits per season effectively doubled from 20 to 30 between 1991/92 and 1994/95 to nearly 60 during 1996/97.

Table 5.2 Percentage of sites in the Maritime Antarctic subjected to different levels of visitation.
Source: Appendix 5.

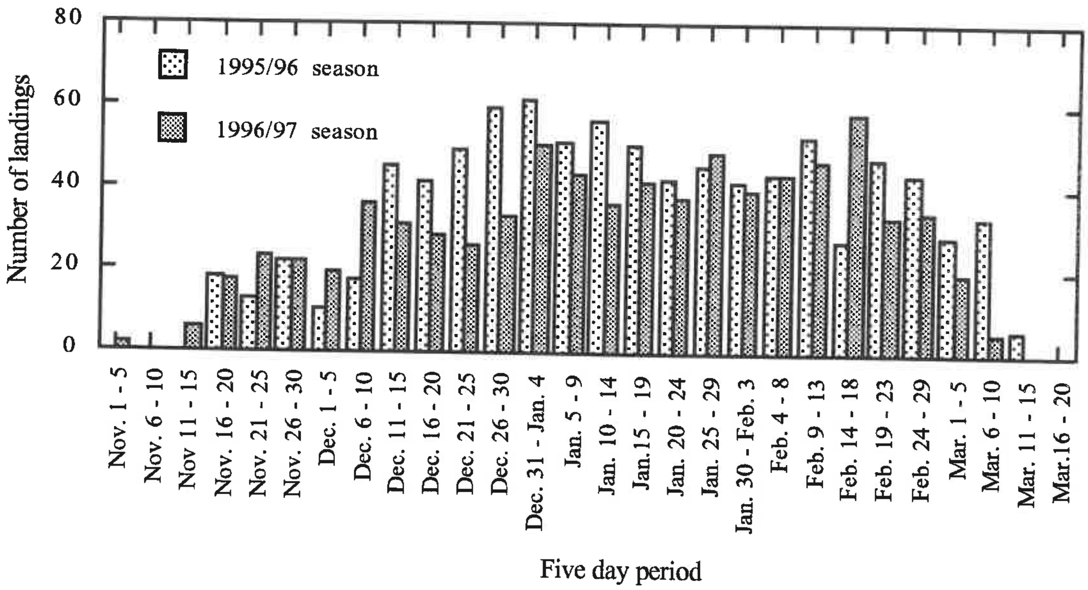
Numbers of visits to individual sites 1989/90 to 1996/97	Number of landing sites	Percentage of total number of landing sites
Visited only once	42	33%
visited 2 – 5 times	25	19%
visited 6 – 10 times	15	12%
visited 11 – 20 times	14	11%
visited 21 – 50 times	12	9%
visited 51 – 100 times	8	6%
visited 101 – 200 times	6	5%
visited 201 – 300 times	6	5%

New sites are added to the list each season. For example, on the northeast side of the Antarctic Peninsula the disintegration of the Prince Gustav Ice Shelf enabled ships to visit areas that were previously completely blocked to shipping (Crosbie and Splettstoesser 1997). From this event eight new tourist landing sites have become accessible, some of which (for example Crystal Hill and Devil Island) have already received several visits (Appendix 5).

5.4.2 Seasonal activity at landing sites

Figure 5.1 shows the frequency of landings during two typical seasons, 1995/96 and 1996/97, at 5-day intervals from early November to mid-March. In both the number rose slowly during November and December, peaked during late December and early January, remained fairly constant until mid-February, then dropped off rapidly. This pattern closely corresponds to the numbers of ships operating at different times of the season, as shown in the calendar of forthcoming voyages prepared before the start of each season and distributed annually at the NSF/IAATO meetings.

Figure 5.1 Landing frequency during the 1995/96 and 1996/97 seasons. Data: NSF and IAATO.



Within this annual pattern, the frequency of landings varies, mainly according to weather; although snow, rain or cold tend not to inhibit landing activities, winds above 30 knots, and swell resulting from winds, prevent the safe operation of Zodiacs and keep passengers on board.

That the highest frequency of landings occurs between late December and late February has implications for wildlife. This is the period when, for example, most penguins and other seabirds are in late incubation or feeding chicks, while young, non-breeding birds are seeking nest sites and 'play-nesting' (Nimon, 1997). Thus sites with nesting birds will be especially vulnerable to unruly or thoughtless passenger behaviour, and crowded sites may become impassable by visitors without some level of disturbance.

5.4.3 Annual trends in landing site activity

The number of shipborne tourists visiting the Antarctic annually has increased nearly three-fold from 1989/90 and 1996/97 (Section 3.3). For the Maritime Antarctic alone, the number of passengers, vessels operating, voyages undertaken, shore landings made and sites visited have all increased, more or less in parallel, during this period (Table 5.3, Figure 5.2).

The five variables all show increases during the whole period. Four of the five show slight decreases during 1996/97, with the decrease in number of passengers most marked. The number of visited sites increased each season, except for a dip of three between 1994/95 and 1995/96.

Passenger numbers rose steadily from season to season until 1996/97. As discussed in Section 3.3.2.3, this decline was due to the absence of two ships.

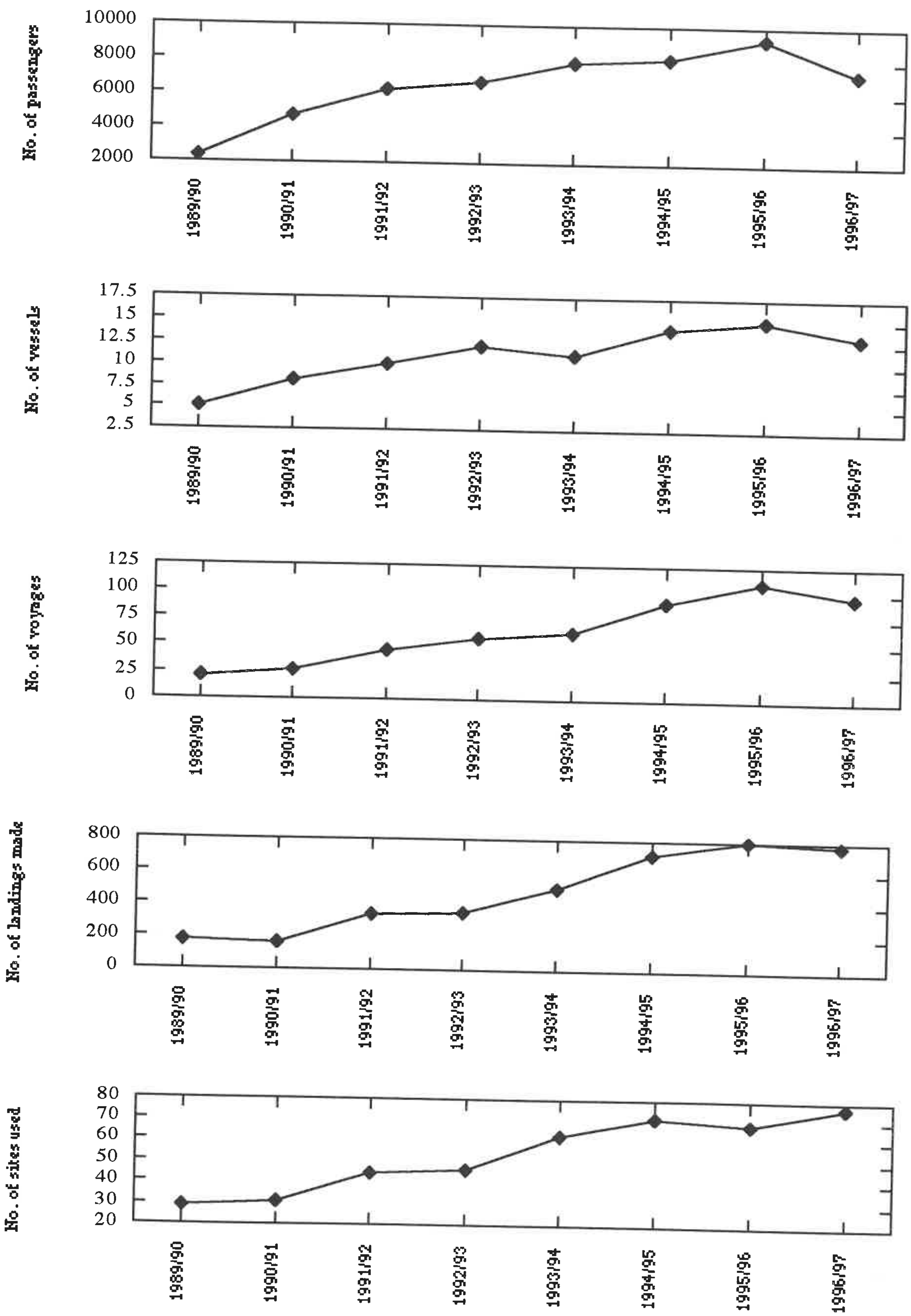
This absence corresponds to the smaller number of ships during the 1996/97 season, following an almost steady increase. One ship fewer operated also during 1993/94. However this particular decrease was not reflected in the number of passengers because of the capacity of the vessels that continued to operate. For example, *Ocean Princess* (250 passengers), *Illiria* (100 passengers) and *Northern Ranger* (80 passengers) operated during 1992/93, but none returned in the following season: the first sank off South America, the latter two were sold. Passengers who might have travelled with them in 1993/94 travelled instead aboard *Marco Polo* (500 passengers), *Hanseatic* (180 passengers) and *Akademik Ioffe* (80 passengers) all of which began Antarctic cruising in that season.

Table 5.3 Number of passengers, ships, voyages, landings made and sites used in the Maritime Antarctic 1989/90 to 1996/97. Sources: Enzenbacher (1993a); IAATO (1997a); and Headland (*pers. com*).

Season	No. of passengers	No. of ships	No. of voyages	No. of landings made	No. of sites used
1989/90	2460	5	21	171	29
1990/91	4698	8	26	166	31
1991/92	6317	10	46	334	44
1992/93	6704	12	57	353	46
1993/94	7957	11	63	499	62
1994/95	8098	14	91	717	71
1995/96	9299	15	109	799	68
1996/97	7322	13	96	782	77

There was a sharp increase in the number of voyages each season between 1993/94 and 1995/96 and, compared with the number of vessels and passengers, a less dramatic decrease during the 1996/97 season. Both trends can be explained by the advent of several small Russian vessels, with capacities of between 30 and 50 passengers, providing shorter itineraries and cheaper, 'no-frills' conditions aboard — a development due to the Toronto-based company Marine Expeditions, which first operated (under the name Polar Expeditions) in 1993/94 (Section 4.2.1).

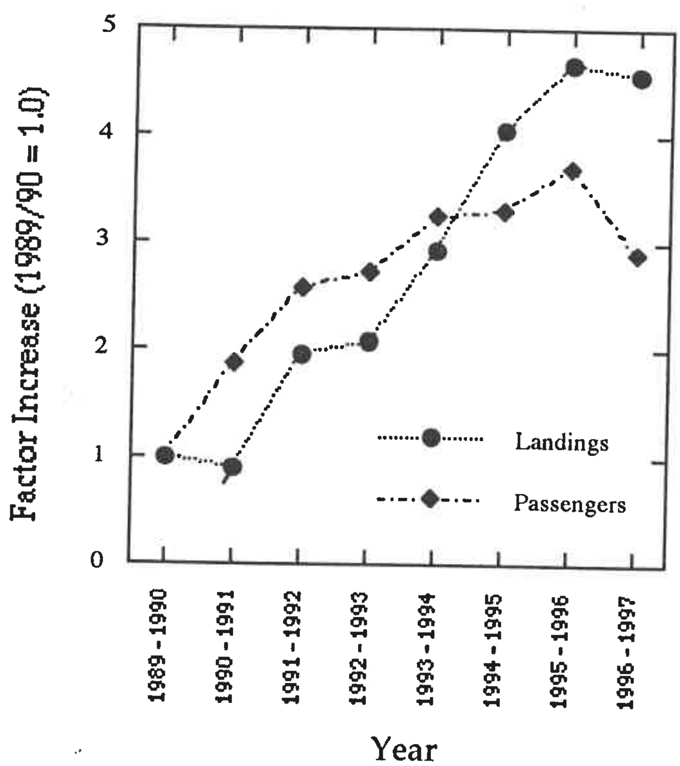
Figure 5.2. Numbers of passengers, vessels , voyages, landings and sites visited 1989/90 — 1996/97.
Sources: Enzenbacher (1993a); IAATO (1997a); and Headland (*pers. com*).



The number of landings made each season also increased erratically during the eight-year period, with a sharp annual increase between 1992/93 and 1995/96. Compared with the previous variables, the decrease in the number of landings during the 1996/97 season was minor, dropping only 17 from the previous season's 799 landings.

Finally the number of sites being used per season has shown an almost steady increase throughout the eight years, except for 1995/96 when the number dropped slightly (71 to 68), only to rise again to a record of 77 in 1996/97.

Figure 5.3 Factor increases in number of passengers and of landings 1989/90 to 1996/97.



Trends in the five parameters indicate that numbers of landing site visits are not a simple function of numbers of passengers carried. Rather, there has been an increase in the number of landings. Figure 5.3, plotting the factor increase both for landings and for passengers since 1989/90, indicates not only that increasing numbers of passengers were carried and more landings made, but that each passenger landed more often in the later years. This suggests that some operators see merit in making their vacations more active, a trend that is likely to bring increasing pressure on the more popular landing sites. Conversely, a decline in the number of tourists may not necessarily reduce pressures on the sites.

5.4.4 Relationships between growth variables

Table 5.4 presents the number of voyages, passengers, landings and sites used, combined in ratios to illustrate particular trends.

The number of voyages per ship has increased, and the number of passengers per ship has decreased. However, the number of landings per voyage has remained relatively constant between extremes of 6.19 and 8.14, showing no clear trend. However, the number of landings per site has increased steadily, indeed almost doubled, during the same period.

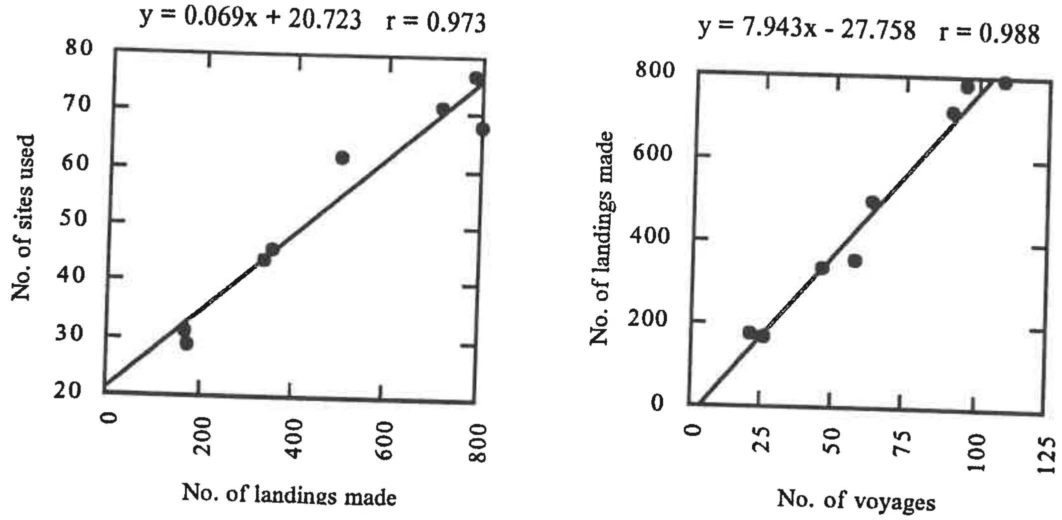
Table 5.4 Number of vessels, voyages, passengers, landings and sites used since the 1989/90 season as ratios.

Season	No. voyages per vessel	No. passengers per voyage	No. landings per voyage	No. of landings per site used
1989/90	4.2	117.1	8.14	5.89
1990/91	3.3	180.7	6.4	5.35
1991/92	4.6	137.3	7.3	7.59
1992/93	4.8	117.6	6.19	7.67
1993/94	5.7	126.3	7.9	8.05
1994/95	6.5	88.9	7.9	10.10
1995/96	7.2	85.3	7.3	11.75
1996/97	7.4	76.27	8.14	10.15

Not surprisingly, correlation between the variables are strong ($r \geq 0.846$). The strongest, between the number of voyages and of landings, and between the number of landings and of sites used, are illustrated in Figure 5.4. ~~Yet, they indicate that there has~~

~~landings and of sites used, are illustrated in Figure 5.4~~. Yet, they indicate that there has been no major variation in either relationship (r = 0.988 and r = 0.973 respectively) during the period under review: i.e. whatever the length of the voyage, a certain number of sites needs to be visited to ensure that passengers receive a full complement of Antarctic experience. This suggests that visits to sites must also have become shorter or that less distance is covered during individual voyages. This implies also that, as more voyages are made, more sites are needed to accommodate all the landings that the industry demands, without undesirable congestion.

Figure 5.4 Relationships between the number of sites used and landings made, and between the number of voyages and landings made, in the Maritime Antarctic each season, 1989/90 to 1996/97.



5.5 Discussion and conclusions

Landing sites have been considered in five geographic sub-regions, each with distinct characteristics which affects usage by the industry. The number of sites and the numbers of visits vary widely between sub-regions: the most popular, by far, are the South Shetland Islands and Northwest Antarctic Peninsula. Activities continue to concentrate at a few sites, with 5% of all the sites visited having received over 200 visits since 1989/90. However, the number of visits can be influenced by environmental

Seasonal patterns of landing site use can be derived with the two available seasons data shown in Figure 5.1. Most of the landings take place between late December and the end of February. This coincides with the annual calendars of forecast activity distributed by NSF/IAATO.

Analysis of five variables indicating annual trends in activity illustrate that:

- there has been a greater factor increase in the number of landings than in the number of passengers;
- there has been an increase in the number of voyages made by each vessel;
- there has been a decrease in passenger numbers on each voyage;
- there has been no significant variation in the number of landings per voyage;
- although there are more landings per site, the number of sites per voyage has not varied significantly over time.

Three factors have contributed to the trends noted above: the introduction of more small vessels, with lower passenger capacity; shortening the voyages; and imposition of specific codes of conduct. Firstly, the introduction since 1991/92 of six small ships, each carrying less than 50 people was not followed by an increase in passengers *pro rata*. Secondly, during the 1990s there has been a move towards selling shorter itineraries. For example, in the 1970s and 1980s each vessel was making only three or four voyages per season, each lasting three to four weeks (Reich, 1980; Headland, 1989), currently, voyages to the Maritime Antarctic range between eight and 17 days, with individual vessels making up to 13 voyages (Crosbie, *pers. obs*.). Finally, since 1991, IAATO codes of conduct have modified onshore activities to the extent of not bringing any food or drink ashore (see Chapter 6), thus effectively limiting landings to fewer than three hours. Information on the length of time spent at landing sites is not available. However personal observation by the author, and personal communication from others involved in the industry for the past twenty years, strongly imply that landings are indeed much shorter than in earlier seasons (Splettstoesser, *pers.com.*; Marshall, *pers.com.*).

Thus, the marked increase in the number of landings made each season can be attributed to more and shorter voyages using smaller vessels. Analysis of these data also suggests that a certain number of sites need to be visited for passengers to experience all aspects of the Antarctic. If shore operations are the phase of activity most likely to result in disturbances to the Antarctic biota through repetition, the fact that during the 1996/97 season there was a decrease of 21% in the seasonal number of shipborne tourists visiting the Antarctic, it is offset in impact terms in that there were only 2.2% fewer landings that season.

Chapter 6
Landing site selection and operations

6.1 Introduction

Landing sites, the main contacts between tourists and the environment, are not formally managed. Some have now been visited several times annually for over 30 years. This chapter reviews the processes by which landing sites are identified and selected for use during voyages and how, and to what degree, their individual vulnerability is considered. Much of the material is based on the author's experience as expedition leader aboard *Explorer* for two seasons in the Maritime Antarctic.

As neither the Treaty System nor the trade organisation of the industry has attempted to develop management objectives or plans for individual sites, tour operators have evolved strategies for passenger management impartially. Within broad guidelines provided by IAATO and their individual employers, expedition leaders plan itineraries, incidentally determining the frequencies with which sites are visited. Equally incidental is the way expedition leaders determine how, within the general guidelines, passengers are managed ashore at different sites. Thus two important aspects of responsibility for maintaining site integrity fall on the shoulders of a few individuals.

Information on landing sites is accumulated informally by experienced leaders and collated by some operators, although solely for their use: there is little formal exchange of such information between companies. Many expedition leaders recognise that sites vary in vulnerability, with some needing greater care and sensitivity than others. Two sets of landing site guides (Stonehouse (1995) and Naveen (1997a, 1997b), see also Section 6.6), prepared by independent organisations, have recently been published, drawing attention to differences between sites and suggesting ways for the best passenger management at selected sites.

6.2 Landing site management

Antarctic tourist landing sites have no special recognition or status under the Protocol, and tour operators are free to land passengers where they choose, with the exception of areas scheduled under Treaty recommendations for environmental protection, scientific research or operational purposes (Section 2.5.1). Such scheduled areas are a relatively minute proportion of coastal Antarctica, leaving operators a wide choice of landing areas.

ATCM recommendations concerning the sites request operators to report activities (for example, the Post Visit Report Forms: Appendix 4) and, mainly in hortatory terms, present general points of visitor management (for example, operators should '*... ensure that visitors are supervised by a sufficient number of guides who have adequate training and experience and knowledge of the Antarctic Treaty system requirements*' Recommendation XVIII-1: Procedures for Organisers and Operators A8). No sites are specified by name. Operators have used their freedom to return repeatedly to interesting sites and constantly explore for new ones, adding a few more to the list each year. The strategies promulgated for landing passengers and directing activities ashore, originating from the legacy of Lindblad (Section 3.2.2) and since standardised by IAATO, take only minor account of the peculiarities and vulnerabilities of individual sites.

Although it can be established that many of the sites have been visited for over 30 years, and regularly during the last eight summers (Lindblad and Fuller, 1993; IAATO, 1997a), none has been made the subject of a formal management plan, with provision for defining management objectives, short-term and long-term planning strategies, and monitoring to confirm that objectives are attained. It is arguable that the relatively small numbers of tourists visiting even the most popular sites make such planning unnecessary at this stage. However, in view of the industry's growth and potential for further growth (IAATO, 1997a), it may be prudent to consider possible forms of management that might be applicable should expansion continue.

6.3 Site selection: role of the operators

Decisions to visit or by-pass particular sites are made during the voyage by the expedition leader, in consultation with the ship's master. Prior to the voyage, the leader proposes an itinerary based on company policies and the leader's experience. These in turn reflect policies recommended by IAATO, as consistent with, and conforming to, existing regulations. Thus:

- IAATO sets general criteria for shore operations through its requirements for operators (Section 4.2.3; Section 6.3.1);
- Operators set their own criteria within IAATO requirements, including their emphasis or marketing policies (Section 6.3.2);
- The expedition leader then decides which sites are appropriate to visit during each voyage (Section 6.4).

The expedition leader's decision is based on several factors, including constraints within the itinerary (for example, number of days and vessel speed), weather conditions, operational safety and personal preferences (Section 6.4). Master, officers, crew and staff onboard provide the organisation and operating procedures by which the landing is effected.

6.3.1 Role of IAATO

IAATO's guidelines for tour operators include notes on site selection (Section 4.2.3). Yet IAATO has no (nor is it required to have) management policies for individual sites, and with only two exceptions has not offered guidance on the vulnerability of a particular site.

The exception, in 1995, was a suggestion, promulgated at the annual IAATO meeting (Arlington, Virginia, July 1995) that members should reduce early-season visits to Hannah Point, Livingston Island, because of a danger of disturbing the breeding southern giant petrel colony (Landau, *pers. com.*; see also Table 6.3). The number of annual visits to Hannah Point dropped from 46 during 1994/95 to 37 during 1995/6, but returned to 46 during the following season. Similarly, in 1996 IAATO promulgated a request from Instituto Antártico Argentino, Direccion Nacional del Antártico requesting tour ships to refrain from visiting Nordenskjold's hut on Snow Hill Island (Schoeling, *pers com.*), which was being damaged. The number of visits dropped from four in the previous season to one in 1996/97.

Thus, while IAATO contributes to shore operations through the codes of conduct (see Section 4.2.3), it also has a capability for contributing to site selection. The precedent of influencing site selection has been established, but, as yet, the mechanism has not been greatly used.

6.3.2 Role of individual operators

Each IAATO member has an environmental officer, usually someone with another role in the office such as the operations manager or staffing co-ordinator, responsible for ensuring that officers and staff onboard the vessels are aware of IAATO guidelines and national and Treaty regulations. Each company produces its own 'handbook' for expedition leaders aboard their vessels. The handbook covers company policy on all matters, from operations procedures, to pertinent national legislation and to application of Recommendation XVIII-1 and IAATO requirements (IAATO, 1996b). All operations are then planned within the parameters set by the handbook. Companies that cater for climbing parties or other unusual operations, perhaps involving nights spent ashore, must ensure that their handbook contains appropriate guidelines and codes, including such details as safety and waste management measures (IAATO, 1996b).

Handbooks are not formally exchanged between companies, and as they include material on company policies, the information is regarded as privy. Handbooks do not include guidance on landing site selection — only the standard procedures that are to be followed to ensure safe and operationally successful landings, although a dossier of information on individual sites compiled by the expedition leader is usually appended to the handbook (see Section 5.4.2).

6.4 Site selection: responsibilities of expedition leaders

Cruise ships are usually organised in four departments — deck, engine, hotel and expedition — under the control of the master. The chief officer, chief engineer and hotel manager are responsible for their respective parts of ship. The expedition leader organises the expedition department, with responsibilities that include:

- planning itineraries, selecting landing sites to visit;
- organising staff (including lecturers, guides and Zodiac drivers) and passengers;
- organising the onboard education programme;
- landing procedures;
- safety and observance of codes of conduct by staff and passengers while ashore;
- briefing passengers, ship's company and staff on their responsibilities in the Antarctic Treaty area, including the issue of *Guidance for visitors to the Antarctic* (Appendix 1).

There are two ways in which an expedition leader can arrange to ensure compliance with the codes of conduct and ensure environmentally benign: these are through site selection and through the actual organisation of landing operations.

6.4.1 Itineraries

Site selection occurs in two phases (Crosbie, 1997):

- Usually before the start of individual voyages, either operators or expedition leaders prepare initial itineraries and circulate them amongst the ships involved, specifying where and when they expect landings to be made;
- Expedition leaders make day-to-day adjustments to the initial itineraries, responding to local conditions and opportunities encountered.

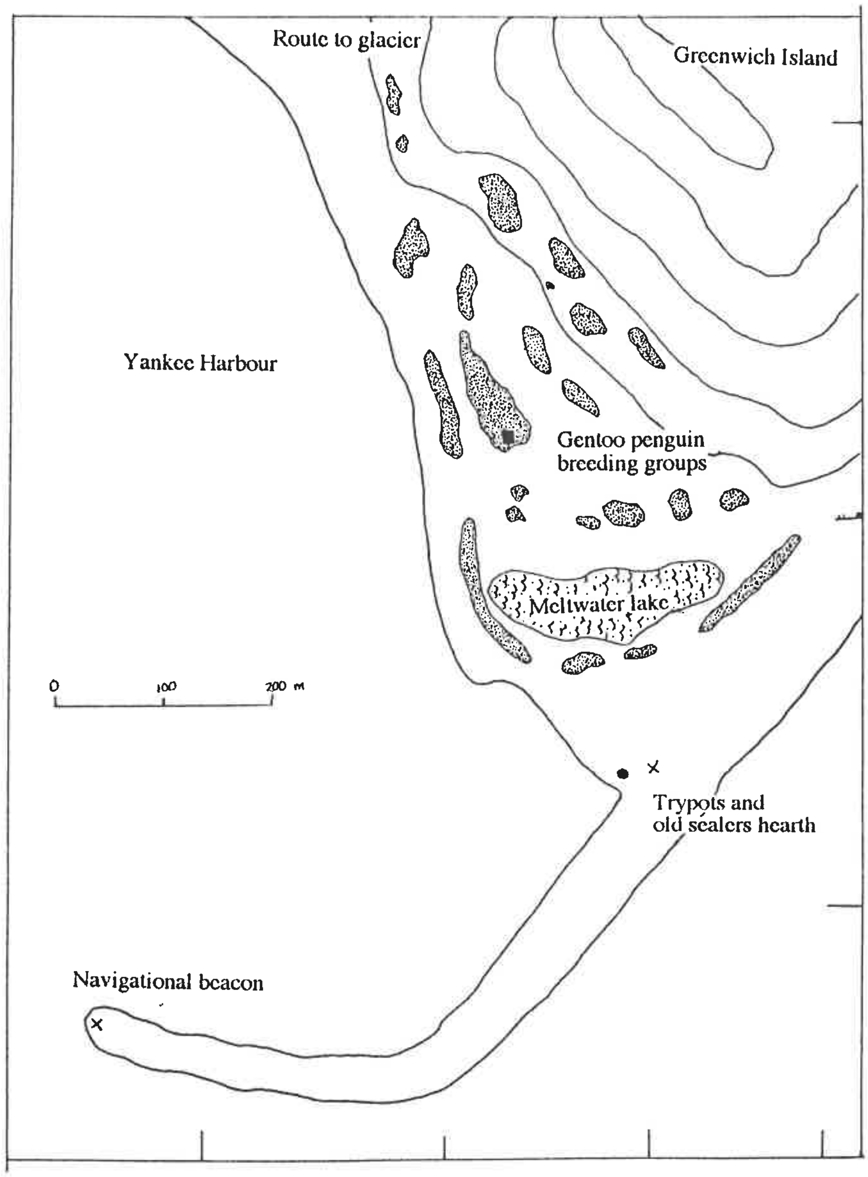
6.4.1.1 Initial itinerary planning

Itineraries are planned to give passengers an overview of the environment and cultural heritage of the area being visited. Almost every cruise to the Maritime Antarctic aims to include visits to several of the following:

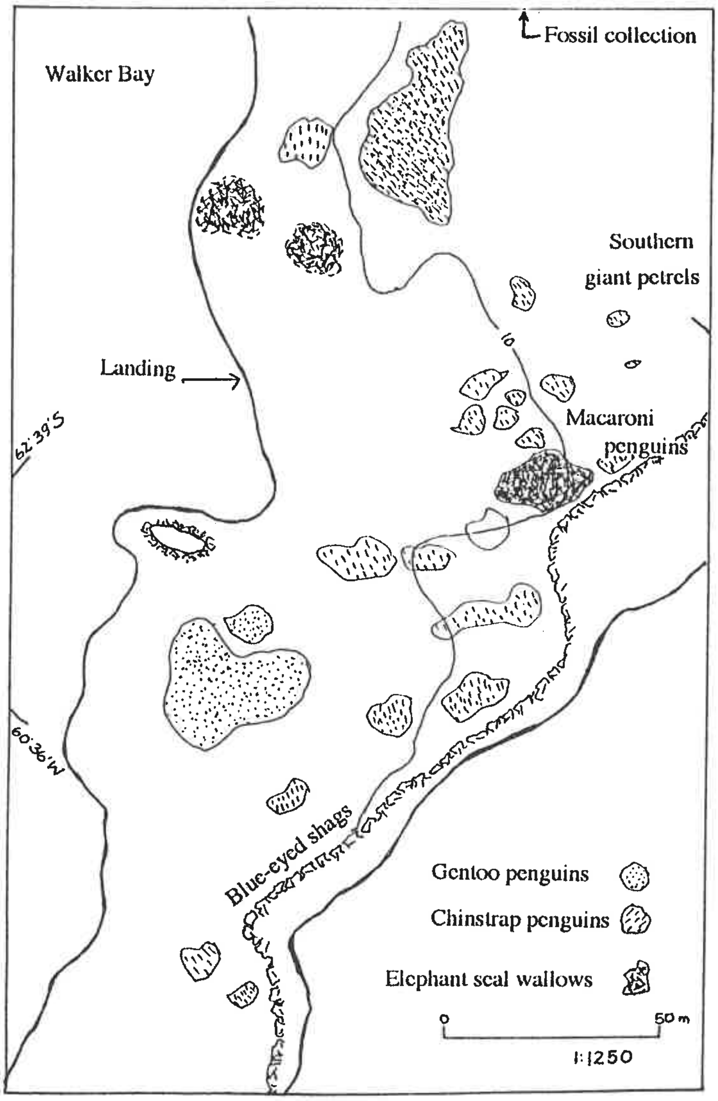
- *renowned or popular sites*, for example Deception Island, Paradise Bay or the Lemaire Channel;
- *sites of natural history* involving a range of birds, mammals, vegetation and geological features, for example Hannah Point or Penguin Island;
- a landing on the Antarctic mainland, for example, Almirante Brown (Paradise Bay), Neko Harbour or Brown Bluff;
- *sites of historic interest*, featuring exploration, sealing or whaling, for example Paulet Island or Port Lockroy;
- *a currently active scientific station*, for example Henryk Arctowski or Palmer.

Sites that meet several of these criteria are those most favoured in itinerary planning. Each voyage is usually started with an easy landing in a sheltered place, for example Yankee Harbour, where a curved lateral moraine provides a sheltered harbour, a wide cobbled beach enables walking without compromising codes of conduct, and there are several points of interest including a gentoo penguin colony, seals, and a sealers' hearth and trypot, all within easy walking distance (see Map 6.1). This gives passengers an easy introduction to the Zodiacs and, once ashore, space to wander freely and acclimatise to Antarctica. Thereafter the aim is to ensure that each day is more exciting or interesting than the day before. Thus more complex sites, for example Hannah Point (Map 6.2) with limited space at the landing site (Davis, 1997; see also Table 6.3) are less suitable as first landings (see below).

Map 6.1 Sketch map of Yankee Harbour, Greenwich Island, South Shetland Islands.



Map 6.2 Sketch map of Hannah Point, Livingston Island, South Shetland Islands.



Prior to each voyage the initial itinerary is circulated to other ships known to be operating in the same area and to In.Fue.Tur (see Section 3.3.1). This effectively 'books' sites, avoiding the inconvenience of two ships trying to land passengers simultaneously at the same site, and provides a means for all expedition leaders to keep track of each ship, for exchanges of information and assistance in emergencies. To the same end, many expedition leaders seek to keep radio contact at least daily with colleagues on nearby ships. As a result, all expedition leaders compile tables such as that illustrated in Table 6.1, which is constantly updated.

1996	Explorer	Alla Tarasova	Boris Petrov	Hanseatic	Ioffe	Vavilov	Khromov	Livonia	Molchanov	World Discoverer	Multanovsky
Jan. 23	Paulet Snow Hill		Half Moon Bellingshausen		Ushuaia	Whalers Bay	Hannah Pt	Prospect Pt	Hope Bay	Elephant Is	
24	Deception					Cuverville Pleneau	Aitcho Deception	Yalour & Vernadsky Petermann & Pt. Lockroy	Frei Marsh Cierva Cove Cuverville Is.	Coronation Is.	Turret Point
25	Damoy Palmer			Ushuaia	Whalers Bay	Pt. Lockroy Paradise Bay	Cuverville & Danco Neko Hrb	Neko Orne	Charlotte Bay Petrel Cove		Cuverville Pleneau
26	Petermann Cuverville & Orne		Ushuaia		Cuverville Is Paradise Bay	Yankee Hbr Bellingshausen	Paradise Bay Pt. Lockroy	Melchior & Portal Point Spring Point	Hannah Point Deception Is Penguin Is	South Georgia	Paradise Hbr Neko Hrbr
27	Aitcho Penguin Is.	Stanley			Pleneau Pt. Lockroy		Petermann & Pleneau Vernadsky	Deception Hannah Pt		South Georgia	Half Moon Bellingshausen
28	Pt. Wild		Whalers Bay	Stanley	Arctowski Half Moon		Yalour			South Georgia	
29			Ronge & Cuverville Paradise Bay			Ushuaia	Fournier Hydruga Rk		Ushuaia		
30			Vernadsky Petermann	Elephant Is				Ushuaia			Ushuaia
31	Stanley	Penguin Is	Half Moon & Bellingshausen Aitcho	Paulet Weddell Sea	Ushuaia	Whalers Bay			Penguin Is		
Feb. 1		Pt Lockroy Petermann		Alm. Brown Petermann Is		Neko Harbour Paradise Bay	Ushuaia	Arctowski Aitcho & Yankee Hrbr	Paulet Is Seymour	Stanley	Turret Point
2		Paradise Bay Cuverville		Deception Hannah Pt.	Whalers Bay	Palmer Pleneau		Deception	Astrolabe Cierva Cove		Cuverville Neko Hrbr
3	Pt. Wild	Yankee Hbr Half Moon	Ushuaia		Cuverville Paradise Bay	Cuverville Melchior Is		Ronge & Danco Neko Hrbr & Alm. Brown	Danco Neko Harbour		Petermann Is. Paradise Bay
4	Brown Bluff Paulet Is.	Hannah Pt. Deception			Pleneau Pt. Lockroy		C. Melville Ferraz	Petermann & Pleneau Melchior Is	Palmer Petermann	South Georgia	Deception Bellingshausen
5	Snow Hill James Ross Is		Whalers Bay	Ushuaia	Arctowski Half Moon		HopeBay Paulet		Pleneau	South Georgia	
6	Deception		Ronge & Cuverville Paradise			Ushuaia	Trinity Is. Charlote Bay		Ronge Portal Point	South Georgia	
7	Cuverville & Waterboat Pt.	Ushuaia	Vernadsky Petermann	Arctowski			Pt.Lockroy Petermann	Ushuaia	Hannah Point Pendulum		Ushuaia
8	Petermann Dallmann		Orne Portal Point	Hope Bay Paulet	Ushuaia	Whalers Bay	Paradise Bay Melchior Is.			Orcades	

Table 6.1 Tourist ship initial itineraries, 23 January to 8 February 1996.

Table 6.1 illustrates the initial itineraries for 11 ships for the period January 23 to February 8, 1996. This information would have been distributed by individual leaders to all other leaders around mid-January. Clearly there are some potential conflicts, for example the coincidence of ships in the Cuverville Island/Errera Channel areas on 3 February, that leaders would seek to resolve as quickly as possible.

Grouping the Deception Islands landings (those listed as Deception Island, Whalers Bay and Pendulum Cove) as a single site, and excluding 'Weddell Sea' and South Georgia, Table 6.1 lists 153 proposed landings at 45 sites. Their distribution jointly confirms the relative popularity of the two most frequently-visited sub-regions (Northwest Antarctic Peninsula and South Shetland Islands), and the high popularity of a small number of favoured sites (see Section 5.4.1). The four most popular (Deception, Cuverville and Petermann islands, and Hannah Point), were each scheduled to receive more than 10 visits, and receive almost 30% of all visits between them.

Initial itineraries are based on the assumption that conditions favourable for landing will be met. It often becomes necessary to modify them because of delays or diversions due to weather and ice conditions or alterations to other ships' schedules. Change is sometimes desirable simply to grasp opportunities that arise during a voyage. Phase two of the selection process allows the expedition leader discretion to change at short notice from one site to another.

6.4.1.2 Adjusting itineraries

Most leaders try to ensure that their change of plans does not interfere with other itineraries. Adjustments made 24 hrs or more in advance can usually be notified by radio to other ships that might be affected. In adjusting itineraries, for whatever reason, experienced expedition leaders will be aware of alternative sites that can be used at short notice, under better or safer conditions, and which will provide an experience similar to that which is being missed.

6.4.2 A sample itinerary

Table 6.2 presents a typical itinerary for Days 3 – 8 (the period spent in Antarctic waters) of a nominal 11-day cruise from South America. This is a straightforward itinerary, selecting many of the 'popular' sites, i.e. ones that, for their interest and reliability throughout the season, are likely to feature in many other itineraries. Landings are limited to two, or at most three, per day. There are several alternatives for each site, and the itinerary would be unlikely to involve operators in expensive overtime or fuel bills.

Table 6.2: Sample itinerary for a Maritime Antarctic voyage., with alternative sites. Days 1, 2 and 10, 11 are days in port or enroute.

Day		Site	Reasons for selecting site	Possible alternatives
3	am	Sea		
	pm	Yankee Harbour	Nearest landfall to South America. Easy, sheltered landing. gentoo penguins, often Weddell and Antarctic fur seals, historical interest. Plenty of room near landing site and wide routeways between attractions.	Penguin Island, Half Moon Island (rich wildlife)
4	am	Hope Bay, Antarctic Sound	Historical hut, Argentine station visit, continent landing, possible walk to a small lake and Adélie penguins.	Brown Bluff (penguins, geology), Petrél Station or Kinnes Cove
	pm	Paulet Island, Weddell Sea.	Adélie penguins, blue-eyed shags, historical site (exploration). Note the site is best visited at low tide for walking along beach away from juveniles on shoreline.	Danger Islands (penguins, geology)
5	am	Devil Island, Erebus and Terror Gulf	Adélie penguins, hike, possible killer whales, bottleneck between penguin breeding groups near landing, space for walking.	Snow Hill Island (historic site, geology)
	pm	Crystal Hill, Prince Gustav Channel	Continental landing, exposed mineral seams, including exposed amethyst geodes; no wildlife, hiking possible.	James Ross Island (historic site, geology)
6	am	Whalers Bay, Deception Island	Historical site (whaling) close views of pintado petrels, long clear beach for walking. Be aware of SSSI far side of aircraft hanger.	Bailey Head (huge chinstrap penguin colony)
	am	Pendulum Cove, Deception Island.	Bathing in hot springs, must keep clear of SSSI.	Telefon Bay (volcanic crater) Decepcion Station (museum of vulcanism)

	pm	Hannah Point, Livingston Island	Macaroni, chinstrap and gentoo penguins, elephant seal wallows, fossils, possible hike on long beach.	Half Moon Island (rich wildlife)
7	am	Cuverville Island, and Rongé Island, Errera Channel	Cuverville Island has gentoo penguins, very scenic, clearly defined edges of breeding groups, long beach and hill for walking. Zodiac cruise of ice enroute to Rongé which includes chinstrap penguins and seals.	Danco Island (closed station, penguins, walking)
	pm	Paradise Bay, off Gerlache Straits	Zodiac cruise with spectacular scenery, mountains, glaciers, ice-cliffs. Possible close views of blue-eyed shags, usually crabeater and Weddell seals and often humpback and minke whales.	Waterboat Point, Gonzalez-Videla Station (historic site, closed station, elephant seals, penguin colony). Neko Harbour (gentoo penguins and continent landing)
	pm	Lemaire Channel cruise	Cruise through renowned scenery - remain on board.	Cruise through Wauermanns Islands
8	am	Petermann Island and cruise south of Lemaire Channel	Adélie and southernmost gentoo penguins, historical site (exploration) grounded icebergs, very scenic, can divide group so half ashore, half on Zodiac cruises of ice at a time. Possible to cruise south with ship for furthest south.	Pleneau Island (penguins, elephant seal wallow)
	pm	Port Lockroy, Wienke Island.	Historic site, postal point, scenic, gentoo penguins, whaling artefacts and museum.	Dorian Bay (refuge and gentoo penguins, possible good walk and views)
	pm	Dallmann Bay cruise	Humpback and killer whales often feeding, whale watching from ship.	Return voyage along Gerlache Strait
9		Sea		

Table 6.2 lists the highlights and *raison d'être* for selecting the sites. Yankee Harbour (Map 6.1), normally reached in the late afternoon of Day 3, is a popular choice for first landing (see above).

The ship crosses Bransfield Strait overnight enroute to the tip of Antarctic Peninsula, where a mid-morning stop at Hope Bay provides passengers with visits to an Argentine military and scientific station, an old British station now under the auspices of Uruguay, a historic stone hut from the Nordenskjöld expedition, and a large Adélie penguin colony. If ice conditions allow, the ship proceeds during lunch through Antarctic Sound to Paulet Island (Adélie penguins, blue-eyed shags, and a second Nordenskjöld expedition hut).

Day 5 provides an extended cruise among tabular icebergs and, if the pack-ice allows, two or more landings on islands or the mainland along the east coast of the Antarctic Peninsula, providing a glimpse of an environment closer to that of the Continental Antarctic (Section 1.4.1), and the settings of the expeditions of Otto Nordenskjöld and Sir Ernest Shackleton. Overnight, the ship returns, to the South Shetland Islands. Day 6 starts with two morning landings in the crater Deception Island. At Whalers Bay, passengers visit a derelict whaling station and nesting pintado petrels; at Pendulum Cove they have the opportunity to wallow in geothermally-heated sea water.

On the afternoon of Day 6 passengers experience for the first time the abundant wildlife possible in a small area at Hannah Point, including large colonies of gentoo and chinstrap penguins, a small number of macaroni penguins, giant petrels, Dominican gulls, sheathbills and other breeding birds, all nesting close to the most often used landing point. Unlike earlier landings, it requires care from passengers and staff to avoid contravening codes of conduct.

The last days 7 and 8 are spent in the spectacular Northwest Peninsula sub-region. This is the area which features most prominently in brochure photographs offering extensive wildlife viewing in spectacular scenery including the renowned Paradise Bay and Lemaire Channel. The history of expeditions in these waters (for example, Jean-Baptiste Charcot's and Adrian de Gerlache's expeditions), coupled with the furthest south point for the cruise (usually 65°10'S) and, in the second half of the season, good whale watching ensures that the cruise finishes with memorable events and natural highlights.

Throughout the itinerary there are sites nearby which offer alternatives should conditions prevent a particular landing. Table 6.2 shows some of the alternative sites that are possible, in each case within a short distance and offering similar attractions, should the site of first choice prove inaccessible. A wide choice of alternatives provides economical contingencies for every cruise. Only rarely is a voyage disrupted for more than a day by bad weather or unseasonable pack ice. Inventive and experienced expedition leaders introduce an element of adventure, and quickly find alternatives that help to make the voyage memorable.

6.4.3 Visits to 'previously unvisited sites'

Each season expedition leaders land at a few sites that have not been visited previously. Opportunistic visits are rarely pre-planned: more often they arise from adjustments to itineraries, although occasionally simply to explore a new area. Before landing passengers, the expedition leader and staff usually reconnoitre the site to assess practicability, environmental sensitivity, and safety. New landings are reported to the operators, but there are no standard assessment procedure to be completed, and usually only a brief post-landing report notes what wildlife or other features are present (see Table 6.3).

That expedition leaders are free to make new landings may be considered a freedom to adversely affect sites rich in vegetation or wildlife that have hitherto been untouched. However, the chances that a new landing site will be one of particular scientific interest or biological importance are becoming more remote: the Maritime Antarctic has been well explored by scientists and tour operators. Most sites that have featured as new landings within the last few years, for example False Bay, Livingston Island, have, in fact received very few subsequent visits, as often as not because sites were not found to be particularly attractive.

More often than not, most of the sites that yield rewarding experiences for tourists have already been discovered, and new sites are quickly perceived to lack the attractions of other, better-known sites nearby. Only a very few new sites become instantly popular. Devil Island, made more accessible by a massive breakout of shelf ice, with some 4000 nesting Adélie penguins (Crosbie *pers. obs.*) attractive scenery and space for walking, has been visited 13 times since the first landing in 1995/96.

6.5 Organising landings

Tourist landings following the Lindblad pattern have been described in Section 3.3.2. From the perspective of the expedition leader, these landings can be described in the following way.

Before landing passengers, the expedition leader first scouts the landing site by Zodiac, assessing how the landing should be organised, and looks for any particular hazards (for example, brash ice along the shore, thick snow or the presence of Antarctic fur seals). The time required for scouting and assessment varies depending on the distance to, and complexities of, the site, and how well the expedition leader knows it. By radio the leader then organises staff, and relays any messages to be given to passengers over the vessel's announcement system (for example, informing passengers of conditions ashore and specific reminders on conduct ashore). Staff are first ashore, taking positions at specified points, or scouting routes for walks. As passengers come ashore, the expedition leader, if conditions require, has a further opportunity to brief them after they disembark from the Zodiac.

During each landing, passengers are given a defined area to visit. There are various methods of control available to guides depending on local conditions.

- *Landings can be staggered.* This involves putting half the group ashore while the other half take Zodiac tours near the site, then alternating groups after a specific time and thus avoiding all the passengers landing at once. This is a useful control at a site like Port Lockroy where there is restricted room to move passengers and there is a limit on the numbers in the hut at any time
- *Zodiac cruises* are a useful way of containing the groups when conditions on shore are too crowded with wildlife or it is physically difficult to land passengers. This is a standard method at sites such as the Yalour Islands and Foyn Harbour in the Northwest Peninsula region (see Appendix 5). The former is crowded with bird colonies and there is little room in which to manoeuvre a group of passengers. At the latter, shore conditions are too difficult for many passengers, with steep snow slopes and uneven landings.

Figure 6.1 Zodiac cruising amongst the ice-bergs near Pleneau Island, in the foreground are crabeater seals.

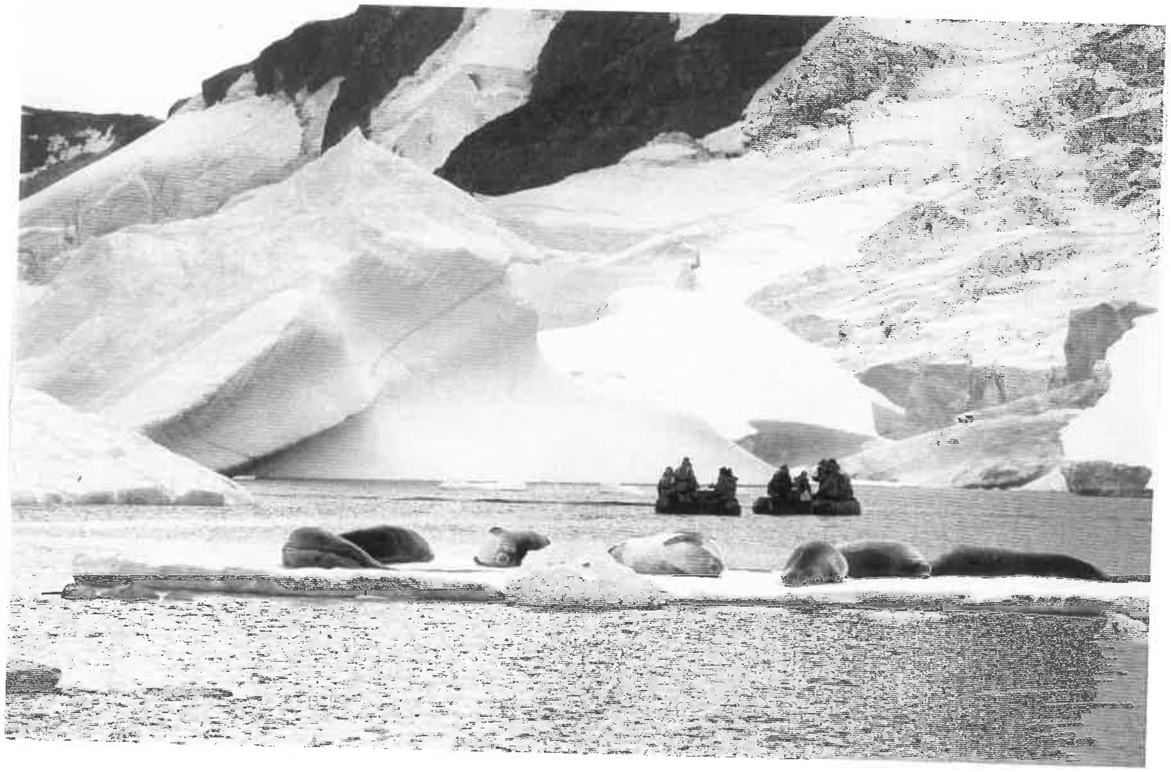


Figure 6.2 Guided walks offer a means of keeping passengers together in groups in situations where it is important to keep distant from the wildlife. This group is being guided by a naturalist in green, and keeping back from elephant seals which appeared to be uneasy.

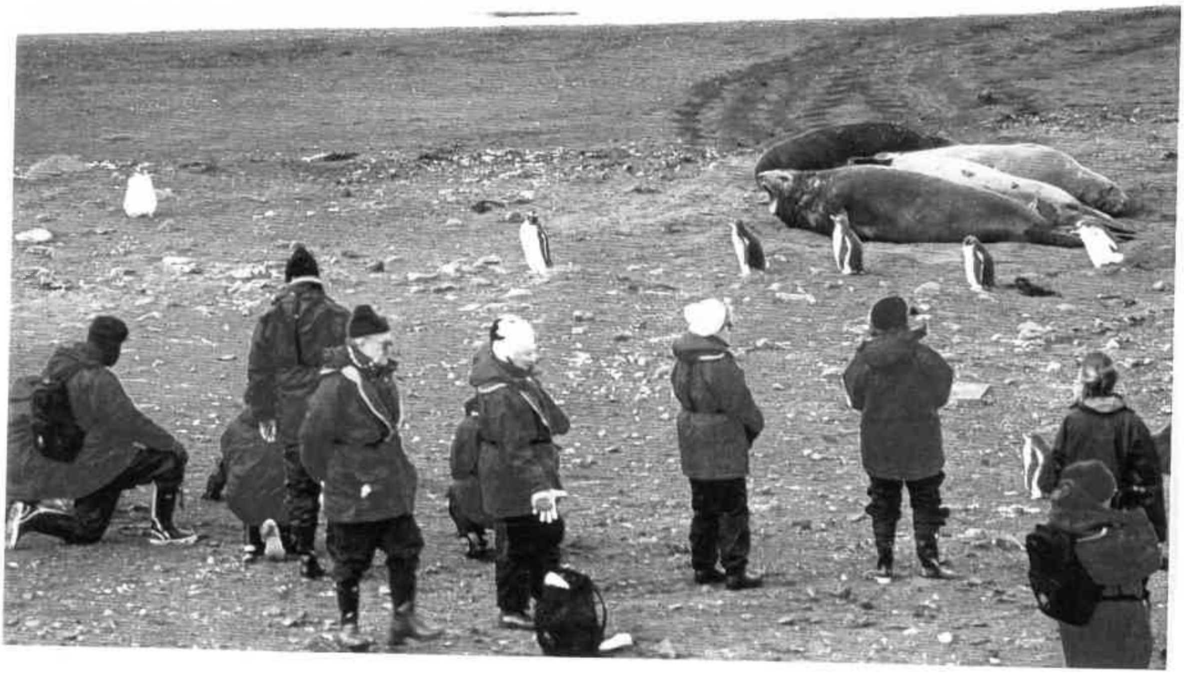


Figure 6.3 Passengers ashore at an unnamed island in the Aitcho Islands This is an area of extensive vegetation, the light green areas are moss beds, the darker green areas are an algae, *Prasiola crispa* , thus passengers need to be reminded to keep off the vegetation.

Figure 6.4 A number of fossils have been collected at Hannah Point over the past five years. The collection includes examples of leaf and branch patterns and is used as an information aid by guides. Neither the author or others (Splettstoesser, *pers.com.)* is aware of any of these fossils being removed since the collection began. Photograph courtesy of Brent Houston.

- *Guided walks* ashore offer a means of maintaining passengers in clusters in order to prevent dispersal and encroachment on wildlife or vegetation. It is a method used often at Hannah Point or the Aitcho Islands in the South Shetlands, where there are often elephant seals hauled out on the beach (Figures 6.3).

  Specific conduct reminders can be used at sites where pertinent. For example: in situations where there are extensive moss beds, it is germane to remind passengers not to trample it, such as at Aitch Island (Figure 6.3); or, at sites where fossils can be found, such as Crystal Hill or Gin Cove, in the Northeast Peninsula region, it is appropriate to remind passengers they can take only photographs and may not remove any items (Figure 6.4).

6.5.1 Accumulating site information

From many frequently repeated visits, experienced expedition leaders develop detailed knowledge of the sites, gathering information in the form of sketches, photographs and written descriptions. Similarly, ship's masters accumulate information about the approaches to each site, anchorage and other data relevant to ship's safety.

Some operators have systems for collating this information and making it available to successive masters and expedition leaders: others do not. Within the best practice, 'site reports' are included with other reference documents accompanying the expedition leader's handbook (Section 6.3.2). A good example of a site report, that for Hannah Point, written in 1992 by Matthew Drennan, one of the industry's most experienced expedition leaders, is reproduced as Table 6.3.

Table 6.3 Extract from MS *Explorer*'s 'expedition leader's site reports'. Courtesy: Explorer Shipping Corporation and M.P.Drennan.

Hannah Point

62°37'S 60°37'W

A small ice-free peninsula on the SW side of Livingston Island, in the South Shetlands.

History:
Named for the sealer *Hannah*, of Liverpool, which was wrecked in the area 25 December, 1820.

Attractions:
One of the most diverse wildlife stops in the area. Nesting penguins include gentoos (over 1000), chinstraps (several hundred) and macaronis (15-25). Other breeders here are giant petrel, blue-eyed shag, skua, sheathbill, Dominican gull, Antarctic tern, Wilson's storm-petrel, and pintado petrel. Elephant Seals are also common.

Marine operation:
The ship can anchor within 1/2 mile of the beach. Use three boats, and one shoremen, depending on conditions. As with many spots in the South Shetlands, this can be a very windy place. The beach is sheltered on either side by spits of rock (see map), but the ride between ship and shore can be quite wet. Follow the track shown on the map - there are lots of rocks near the point. Also watch out for heavy brash ice from glacier.

Conditions ashore:
This is a great stop, but with the introduction of 100 tourists, it becomes very crowded. People really must watch their behaviour here so as not to overly disturb the nesting birds. Compliance with the Visitor's Guidelines should be re-emphasised when briefing passengers for this landing.

Try to get passengers split up into small groups, then have a lecturer walk with the groups so as to best spread people around the area. The walking is all on rock, or snow and ice, depending on weather trends. It can be slippery, but there is no strenuous hiking or climbing. It would be possible to see all wildlife here without going more than 50 meters from the Zodiacs. Walkers can go towards base of point, then along flatland to jumble of large boulders where a good collection of fossils has been amassed over the past few years.

Watch out for moss bank near fossils, as well as terns and storm-petrels nesting in scree. Antarctic fur seals are not numerous, but they do occur here - beware.

Comments:
I don't advocate going to this site before late-December, at the earliest. The reason is that prior to then many of the birds are still on eggs, and are prone to leaving their nests when people come ashore. This is particularly true of giant petrels and Dominican gulls. On a visit early in the 1990/91 season we observed considerable egg-loss of these birds as a result of predation by sheathbills and skuas. This is a significant impact, and we should try to avoid it. This was not a problem with visits later in the season as chicks were not such easy targets and were able to defend themselves.

MPD; Aug. 1992.

Although for many sites these informal reports provide the most detailed information available anywhere, the material is not standardised in any way or exchanged between ships. Because some operators consider that sound site information gives them operational advantages over rivals, co-operation within IAATO does not extend to formal exchanges of such information between operators. Expedition leaders take a more liberal view, exchanging information freely among themselves, and making a point of informing their colleagues by radio of day-to-day changes in site conditions throughout the season.

6.6 Recognising site individuality

Thus both frequency of use among the 128 landing sites listed for the Maritime Antarctic (Appendix 5), and ways in which the sites are used depend heavily on the personal preferences and experience of a few individuals within the industry — the expedition leaders. In view of their very wide range of backgrounds and experience, heterogeneity and diversity is inevitable amongst the views of this group. There are neither professional nor trade qualifications for those who lead tourist expeditions in the Antarctic. Some of today's leaders were previously Zodiac drivers, others guides or lecturers, others again cooks or hotel managers.

While most come to Antarctica with experience of cruise operations elsewhere, only a few are trained naturalists, and even fewer are trained biologists with experience of managing wilderness for recreational purposes. Whatever their background, expedition leaders with several years' experience have gathered useful information about landing sites, for future, less experienced leaders. However, the information contained in typical site reports does not generally provide what is needed for formal studies of site ecology or management, or even strong recommendations for restrictions on the use of particular sites.

Within the past three years two sets of site descriptions, that include recommendations for managing passengers at individual sites, have become available. These are *Management recommendations for visitor sites in the Antarctic region* (Stonehouse, 1995) and *Oceanites site guide to the Antarctic Peninsula* (Naveen, 1997).

6.6.1 Management recommendations for visitor sites in the Antarctic region

Stonehouse's '*Management recommendations*' were produced in draft form in 1993 and again revised in 1994. They were circulated to particular expedition leaders and other interested individuals for comment. In 1995 a revised draft, including amendments and improved maps, was circulated to leaders, and operators individually and through IAATO. The revised version contained details of six sites or site-groupings (Cuverville Island and Errera Channel, Hannah Point, Petermann, Hovgaard and Pleneau islands, Port Lockroy, Turret Point and Penguin Island, and Yankee Harbour), all in the South Shetland Islands or Northwest Antarctic Peninsula sub-regions.

The sites chosen included some of those most frequently-visited in either region (Appendix 5): all were regarded by Stonehouse (*pers. com.*) as being at risk of permanent damage, some because of inherent ecological vulnerability, others from popularity. The Recommendations summarise data on the natural amenities at each site and incorporate management points. Material for the Cuverville Island area and Hannah Point include accurate surveys of all the prominent wildlife, based on prolonged stays by the PAC team. That for the remaining sites was gathered during passenger landings in the course of normal cruises: one of the objectives was to see if information gathered in this way would prove reliable enough to form a suitable basis for recommendations. Maps 6.1 and 6.2 are from this source.

Stonehouse's aim (*pers. com.*) was to determine whether the industry as a whole, or through IAATO, would be prepared to accept a system of site descriptions and management recommendations assembled in these ways, and to provide for expanding and updating them: i.e. whether the industry itself was ready to co-operate maintaining a system of critical data collection for the landing sites. Although individuals within the industry expressed appreciation and support, expedition leaders valued their copies of the 1995 version, and at least one operator incorporated much of the material into its site-guide (Shaw *pers.com.*), the industry as a whole saw no practical means of taking on the expense and responsibility of continuing the exercise.

The management recommendations in this document were designed primarily to promote awareness amongst operators of a need for standardising management practices. The *Management Recommendations* are empirically based, and therefore generalised, although outstanding management points were noted, such as not disturbing the sealer's hearth and trypot at Yankee Harbour and being vigilant in maintaining distance from the macaroni penguins at Hannah Point are noted.

6.6.2 Oceanites site guide to the Antarctic Peninsula

The *Oceanites Site Guide* (Naveen, 1997a) and the *Compendium of Antarctic Peninsula Sites* (1997b), published in September 1997, together summarise the work of the Antarctic Site Inventory Project. This project, funded initially by the NSF Office of Polar Programs and the US Environmental Protection Agency, aimed to assess whether *... periodic short visits by trained investigators transported by tourist expedition vessels and other platforms of opportunity might provide a cost-effective means to characterise and detect changes in the flora, fauna, and other features of the Antarctic Peninsula visitor sites*. The project also examined *... the possibility of compiling data and information necessary to assess and determine how best to minimise potential environmental impacts of tourism and non-governmental activities* (Naveen, 1997b).

The survey covers forty sites which, following discussions with the author, Naveen grouped into geographical regions similar to those discussed in Chapter 5. The *Compendium* is intended for assessment purposes by governmental agencies, while the *Site Guide* is intended for sale both to tour operators and tourists. .

The *Site Guide* , like Stonehouse's *Management recommendations* , presents general descriptions of individual sites, incorporating some sketch maps and aerial photographs. Along similar lines it mentions areas that need to be avoided or dealt with cautiously, for example at Yankee Harbour, *... stay off the scree slopes to avoid injuring storm-petrels or destroying their crevice nests* , and at Hannah Point *there are southern giant petrel nests on the southern ridge which should not be approached closely* .

However as with the management recommendations (Stonehouse, 1995), the pointers are generalised, and, for tourists adjusting to new surroundings, may be difficult to interpret.

The *Compendium* gives fuller descriptions, including raw data, from the Antarctic Site Inventory Project. In addition to providing descriptions of the individual landing sites, the aim was to assess whether incidental ship visits could be used to monitor sites. Naveen notes in the compendium that although at some sites Inventory personnel were able to complete censuses at certain sites, time, weather or terrain constraints prevented surveys being completed. This 'inefficiency' is reflected in the data which is suffers inaccuracies, or incomplete information, for a number of the sites described. Nevertheless, the *Compendium* provides a good overview of some of the more popular sites in the Maritime Antarctic.

6.6.3 Comparisons

Both the *Management recommendations* and the *Oceanites site guide* are useful stepping stones towards a comprehensive management strategy for landing sites. Both provide expedition leaders with practical information in standard form, recommend disturbance mitigation practices, provide useful indicators to ecological differences between the sites, and indicating different vulnerabilities Although somewhat differing both are specialised opinions.

While the *Management recommendations* concentrates on a total of nine sites, making recommendations for improving management practice at each, the *Oceanites site guide* covers 40 sites, providing more ecological detail and practical guidance for each. Yet both are handicapped by the opportunistic nature of, and time constraints inherent in, their data collection. Neither, in their present form, is able to provide information beyond that which an experienced expedition leader would already be aware of. Furthermore, the handicap of having to rely on tourist vessels for choice and timing of landing opportunity, is reflected in inaccuracies in these data and raises the potential problem of observers failing to note more subtle but nonetheless important components of the site.

6.7 Discussion and conclusions

None of the 128 landing sites catalogued in Appendix 5 receive special consideration under the Antarctic Treaty or Protocol. Ultimately, responsibility for the management of visitors at sites rests solely on the individual guides and, particularly, on the expedition leader. The expedition leader has two main site management strategies available. These are the selection of sites for visiting during each itinerary and the actual management of visitors ashore.

Given their other responsibilities and priorities, the individual management practices deal only with a particular visit to any site. At present the only standard practice dealing with multiple visits to landing sites is the self imposed requirement that no two ships land groups simultaneously.

A major element in the adoption of any successful management or monitoring strategy for tourism in Antarctica will be ensuring that not only does this strategy have the support and co-operation of the tour operators and, specifically, individual guides and leaders.

Standard information on specific sites has recently become available from two sources, both of which include recommendations for visitor management Nevertheless, these recommendations are not obligatory, and incorporate no post-management monitoring to ensure that the recommendations are, or remain, appropriate. While they will clearly play key roles in any future programme of formal site management, it would be unrealistic to expect them to be capable of providing information required for monitoring that might be needed.

Having assessed current management strategies, the next chapter presents a study of tourist use of a popular landing site, and includes research to evaluate, through quantitative data, short-term disturbances on particular species.

Chapter 7.

Cuverville Island: field studies of a landing site

7.1 Introduction

This chapter reports a three-year field study of Cuverville Island, a popular tourist landing site on Danco Coast, Antarctic Peninsula. Undertaken from 1992/93 to 1994/95, the study formed part of Project Antarctic Conservation, a long-term assessment of the environmental implications of shipborne tourism in the Maritime Antarctic region (Stonehouse, 1993; See Section 1.2). Section 7.1.1. introduces the site, giving the reasons for selecting it from other landing sites and briefly describing the research facilities. Section 7.1.2 reviews the objectives and methods of the research programmes. Sections 7.2 to 7.7 reports on each of the main programmes in turn, those of: recording the islands resources; monitoring visitor use of the site; assessing recovery rates of moss species from footprints; evaluating flying bird responses to approaches from humans; studing skua predation behaviour in relation to the presence or absence of visitors; and assessing gentoo penguin responses to human visitors.

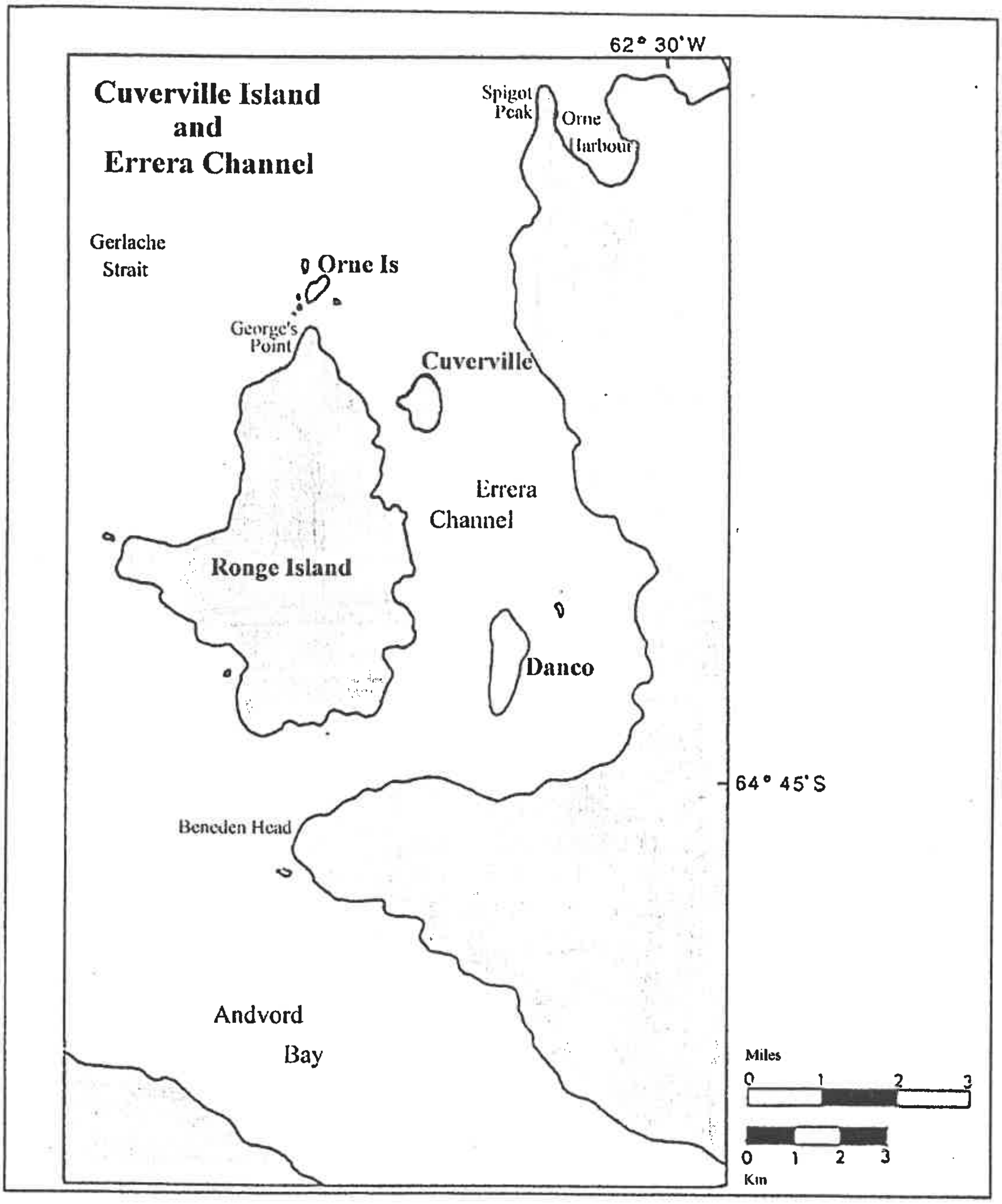
7.1.1 The study site

Cuverville Island is located in Errera Channel, between Rongé Island and Arctowski Peninsula (Map 7.1). Approximately 2 km by 2.5 km, the island is a steep-sided dome of volcanic rock, overlying a granitic basement. The northern two-thirds are covered with a permanent ice cap, which descends almost to sea level in cliffs and ice-falls on the southern and southeastern sides. The northern shore has a raised beach of cobbles and boulders approximately 1.5 km long, backed by steep, moss-covered cliffs toward the east end, and by gentler slopes in the west (Map 7.2). Although it is possible to land at several points of the island, and walk around its shores at low tide, the northern beach has the only landing sites used by tour operators.

Cuverville Island was selected as a study area using criteria based on earlier PAC research on Half Moon Island (South Shetland Islands) during 1991/92 (Stonehouse, 1993). This preliminary study had indicated that, to highlight the issues of tourist effects on landing sites, there was need for at least one detailed study of a representative site, by a team of researchers, extending not more than two or three summers. The ideal site would be popular, providing a succession of visitors throughout summer, with a known (preferably short) history of tourist visits. It would provide a site for a small research station, and opportunities for studying a range of ecological problems or issues related to tourist visits.

From about 100 landing sites identified, three were short-listed and Cuverville Island was selected. Although little was recorded of its natural history, it appeared probably suitable on every count, and offered an important safety factor in the form of a hut on neighbouring Danco Island that might prove useful in emergency. Following infrequent human visits in the 1970s (Müller-Schwarze and Müller-Schwarze, 1975), the island was first visited by a tourist ship, *Explorer*, in 1984 (Splettstoesser, *pers. com*). NSF/IAATO data (1992) indicated slowly-growing popularity. The best information on wildlife came from two BBC cameramen who spent two weeks on the island during 1991/92. They confirmed that the large gentoo penguin colony reported by others (Müller-Schwarze and Müller-Schwarz, 1975; Croxall and Kirkwood, 1979), with breeding stocks of several species of flying birds and a dense plant community, was readily accessible on the northern beach, which was also suitable for siting a small research station.

Map 7.1 Errera Channel, showing Cuverville Island and surrounding environs



Map 7.2 Ecological map of Cuverville Island

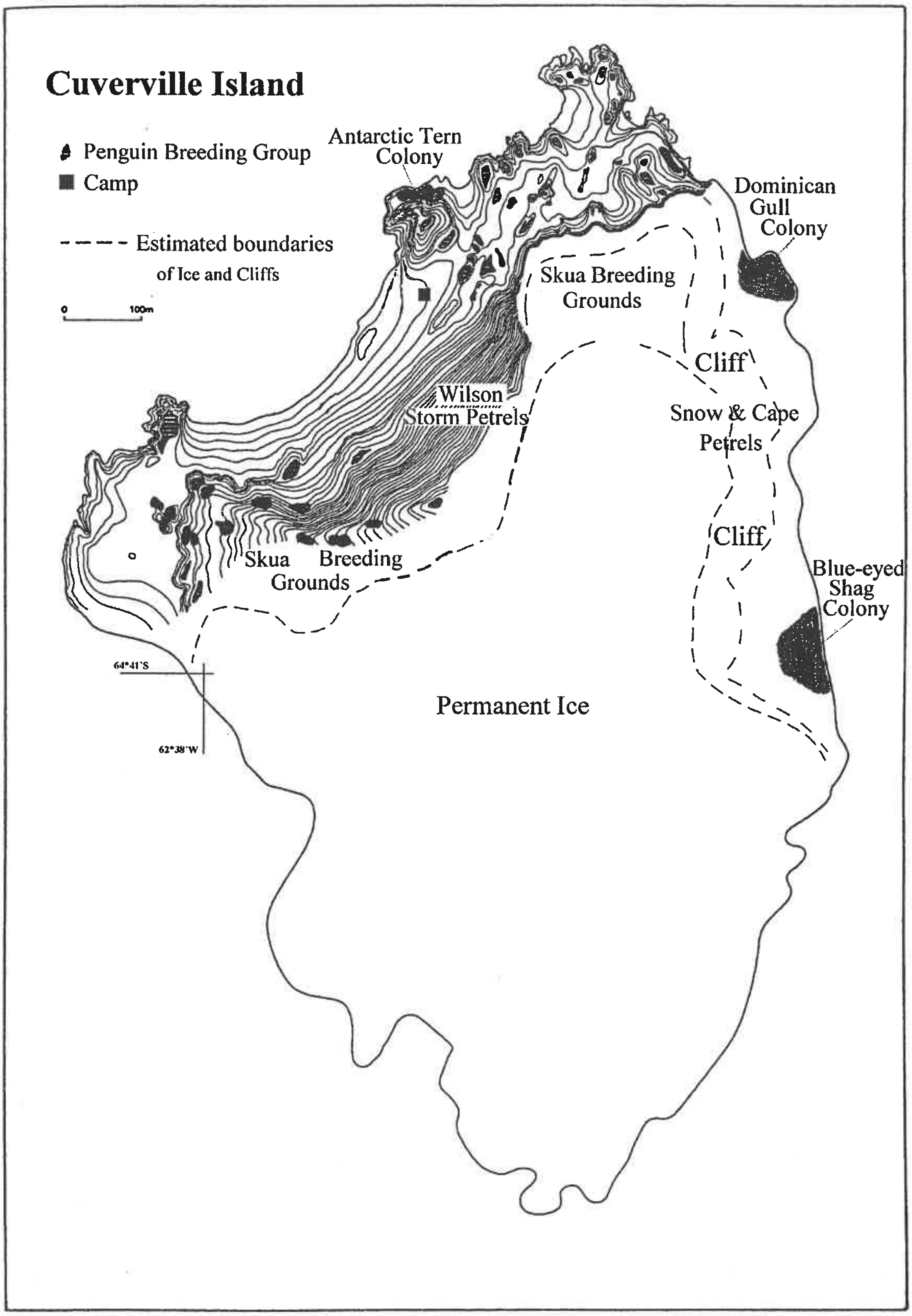


Figure 7.1 The camp on Cuverville Island looking west along the main landing beach towards the Northwest Colony, and Rongé behind.

Cuverville Island proved satisfactory on almost every point. A station of three huts and up to ~~six or~~ seven small two person tents was established on the northern beach 40 metres from the nearest penguin breeding group. The huts were permanent until removed in March 1995: the tents were used only during summer. Teams of between four and seven occupied the station for the three seasons (see also, Table 7.1).

Table 7.1: Dates of occupation of the Cuverville Island station by Project Antarctic Conservation research teams.

Summer	Starting date	Finishing date	Days operating
1992/93	7 December 1992	2 March 1993	84
1993/94	23 November 1993	25 February 1994	93
1994/95	28 November 1994	28 February 1995	92

7.1.2 Research programme

The objectives of the programme were:

- to make an inventory of species that were likely to be affected by visits;
- to record how the island was used by tour operators;
- to investigate, by experiment and observation, some assumptions about effects of visitors on wildlife; and
- to prepare management recommendations for the site.

The first objective involved mapping the island, and cataloguing the vegetation, and animal populations. As the island was unmapped, except in outline (for example, British Admiralty Hydrographic Chart 3213 scale 1:150 000 at lat. 66°30'), it was necessary to produce topographical maps on suitable scales, using plane table and theodolite to establish heights and set form lines. Map 7.2, covering the whole island on a scale of 1:4000, was used to record general ecological information. Maps 7.3 and Map 7.4 cover the northern beach on scales of 1:1000 and 1:2000 and ~~were~~ used for detailed studies in the landing area. Vegetation, and bird and mammal populations were surveyed during the 1992/93 summer, with counts and estimates of breeding populations continuing each subsequent season (Section 7.2); all breeding bird species are noted on Map 7.2 .

The second objective involved logging all ship and yacht visits, recording the number of visitors ashore and their movements there (Section 7.3). This information, with the ecological and topographical surveys, provided the basic information from which studies were developed to measure the effects of visitor activity on particular species (the third objective).

The studies included measuring the results of experimental trampling on moss beds (Section 7.4). Monitoring the behaviour of the four accessible species of flying birds in the presence of visitors this enabled the team to identify two species that were particularly sensitive to human presence (Section 7.5). In a separate study, an investigation was conducted of the predatory behaviour of skuas on penguins in the presence and absence of visitors (Section 7.6). Finally, a major study by team member A. Nimon investigated possible impacts of visitors on breeding gentoo penguins, using changes in heart-rate as a specific stress indicator, and breeding success as a more general indicator of interference with breeding groups (Section 7.7).

Earlier PAC studies had made it clear that impacts of well-behaved groups of tourists, although often repeated, were likely to be small (Stonehouse 1993). It was important, therefore, that the study methods themselves had only very minor or entirely negligible effects. This requirement disqualified many techniques for marking individuals, counting populations, or monitoring heart-rate, making it necessary to develop alternative, non-intrusive techniques. For this, the activities of all researchers were carefully monitored and restricted, avoiding unnecessary intrusions in the study area. Half the penguin breeding area was defined as a control area for the penguin studies, to be visited only twice each season to count breeding pairs. Areas frequented by gulls and terns used only minimally. Thus, in eliminating as much experimental bias as possible, and concentrating on (a) the direct effects of visitors and (b) experimental simulations of their effects, it was possible, with reasonable accuracy, to assess the effects of visitors on critical aspects of Cuverville Island as a landing site. This provided a basis for the fourth objective — the formulation of recommendations for a programme of management and monitoring.

A comprehensive account of PAC vegetation, bird and seal observations, covering research at Half Moon Island, Cuverville Island and Hannah Point, is in preparation by Stonehouse (*pers. comm.*).

7.2 Recording resources

A major objective of the 1992/93 season's work was to identify the area used by tourists (the 'landing site area'), to map it on a practical scale, and to record the abundance and distribution in the area of (a) vegetation, (b) animal species, and (c) other attractions, that were likely to be affected by tourist visits. Other than a few censuses of gentoo penguin populations (for example, Müller-Schwarze and Müller-Schwarze, 1995; Poncet and Poncet, 1987), this was the first detailed assessment of the flora and fauna of Cuverville Island. It was also the first assessment of any tourist landing site for management purposes, other than the preliminary study conducted at Half Moon Island (see above).

To make the findings consistent with research conducted elsewhere in Antarctica (for example, Woehler, 1993) standard methods, such as those recommended by CEMP (CCAMLR, 1992), the Royal Society for the Protection of Birds (RSPB) and British Trust for Ornithology (BTO) (Bibby *et al.,* 1992) were used for assessing abundance, distribution and breeding success of bird and mammal populations. Thus, whenever possible, data on breeding birds were sufficiently standardised to be acceptable to the 1996 report of the SCAR Bird Biology Sub-committee. Counts of breeding populations were made with more deliberation than is normal, usually from well outside the colonies, with minimal disturbance to breeding birds.

7.2.1 Vegetation assessments

Viewed from the north in summer, Cuverville Island appears to be more richly vegetated than other ice-free localities in the area. Prior to the teams arrival, reports of the landing area indicated (Poncet, *pers.com.*; Osborne, *pers. com.*) that mosses were unusually abundant, and it had been suggested that, in places where tourists walked, vegetation might be at risk of damage from trampling (Poncet *pers.com.*). The three-year study involved plans for a survey of vegetation, especially in areas visited by tourists, and experimental trampling to investigate the nature of damage inflicted and rates of recovery. As had been reported, large sections of the north-facing cliffs were covered with dense clusters of moss, growing from thick beds of moss-peat. However, these occurred only on steep cliff faces: the beaches and lesser slopes used by tourists were almost free of vegetation. Vegetation studies conducted by the PAC team, therefore, concentrated in the first instance on the identification and mapping of plants.

Vegetation was mapped intensively in the landing site area, and in less detail around the rest of the island, during the 1992/93 season by C. De Leeuw. This survey was completed during the 1993/94 season by R.Weinstein. Field identifications were based on Smith (1976) and Longton (1988), and later confirmed with the help of botanists from British Antarctic Survey and the Arctic Centre, University of Groningen. The vegetation map of Cuverville Island can be found in De Leeuw (1994). De Leeuw's work contributed to a master's thesis of the University of Groningen (De Leeuw, 1994), but is so far available only as an unpublished preliminary report. Weinstein's report (1994), which confirms and consolidates her work, also remains unpublished.

The survey work revealed a single species of macro-alga (*Prasiola crispa);* 29 species of lichens, mainly of two genera, *Xanthoria* and *Rhizoplaca*, 16 species of bryophytes, notably of the genera *Drepanocladus* and *Polytrichum*, and both species of Antarctic angiosperms, *Deschampsia antarctica* and *Colobanthus quitensis*. Both De Leeuw and Weinstein confirmed that the notable moss banks of Cuverville Island were mainly confined to the steep northeastern and northwestern cliffs above the beach area, and represented the most extensive vegetation of any island in the Errera Channel area. DeLeeuw attributed their richness to their sun-facing aspect, coupled with a summer-long supply of melt water from the island's ice cap. Pockets of soil and moss-peat amalgamated on cliff faces under the actively-growing *Polytrichum* spp., to form banks many decimetres thick. Some of these banks represented accumulations over several centuries of growth (Smith, 1996b). Longer-term observations revealed turn-over and redistribution of moss-peat, due to water-logging and slumping. Slips occurred, leaving scars of exposed moss-peat two to three metres wide and up to 15 metres long, and many old scars, partly or completely revegetated, indicated the propensity of *Polytrichum* species to recover from such major disturbances within a few seasons.

As the vegetation was well out of the way of visitors, disturbance to it was not considered to be an important aspect of tourist environment interaction on Cuverville Island. However, the wealth of botanical species recommended the island as an appropriate location for an initial investigation of the vulnerability of common species to single footprints. This work was initiated by De Leeuw in 1992/93 and followed up by Weinstein in 1993/94 (see Section 7.4 below).

7.2.2 Bird and seal populations

Nine species of sea birds were found breeding on Cuverville Island. Their populations were counted by methods consistent with those of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR, 1992), the Royal Society for the Protection of Birds and the British Trust for Ornithology (Bibby, *et al* ., 1992); the application of these methods to the gentoo penguin census is described in Nimon (1997).

For six of the species (gentoo penguin, skua spp., Domincan gull, Antarctic tern, sheathbill and blue-eyed shag), counts of occupied nests were made each season during the peak laying period, and counts of chicks before or at the start of fledging. Reproductive success was calculated by dividing the number of fledglings by the number of nests. Populations of the remaining three species (cape petrel, snow petrel and Wilson's storm-petrel) could not be counted with great accurately. Cape petrels and snow petrels nested on cliff tops inaccessible to us: individual nests were identified through binoculars. Wilson's storm-petrels nested in scree areas, mostly on steep inaccessible slopes.

Results of these counts are summarised in Table 7.2. Records from three consecutive seasons provided a base suitable for comparisons with earlier records and future years. Data from Table 7.2 will be discussed in the relevant sections below.

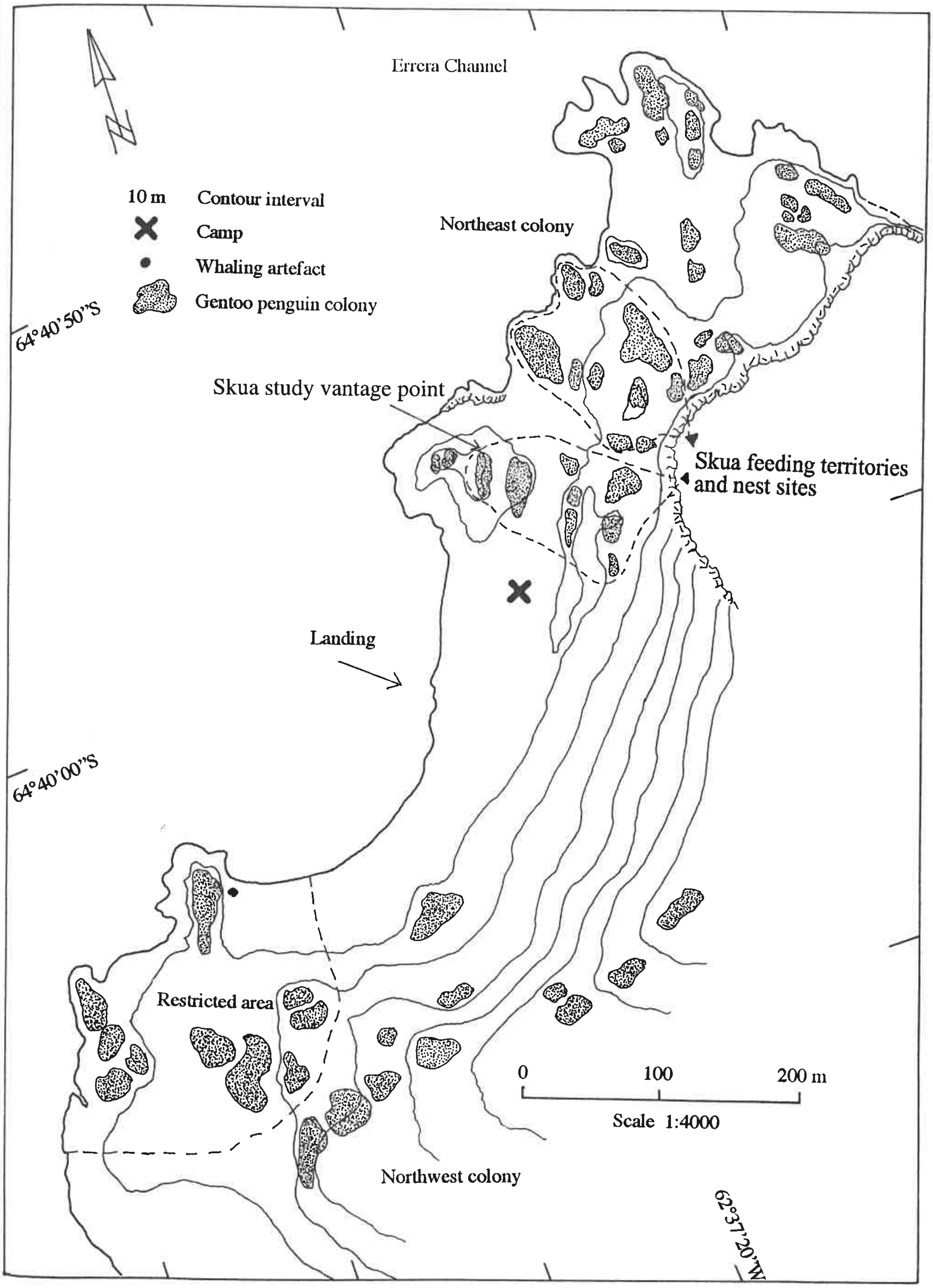
Table 7.2: Numbers of breeding pairs and estimated breeding success of nine species of birds breeding on Cuverville Island, 1992–95. Populations of penguins, skuas, gulls, sheathbills, shags, and cape and snow petrels are based on numbers of nests counted at peak of nesting season: numbers of terns and Wilson's storm-petrels are based on estimates of apparently breeding birds. For details of individual species see text.

Species	Numbers of breeding pairs			Estimated accuracy of counts	Mean breeding success
	1992/93	1993/94	1994/95		
Gentoo penguin	4294	4421	4818	± 5%	1.21
Brown and McCormick's skua	64	101	96	± 5%	1.02
Dominican gull	54	47	42	± 5%	0.14
Antarctic tern	28	27	24	± 5%	0.3
Sheathbill	5	4	4	± 5%	Unknown
Blue-eyed shag	128	94	72	± 5%	1.36
Cape petrel	4	5	6	± 50%	Unknown
Snow petrel	-	1	1	± 50%	Unknown
Wilson's storm-petrel	35	100+	100+	± 30%	Unknown

7.2.2.1 Gentoo penguins

Forming the largest and most prominent breeding groups on the island, gentoo penguins were the birds most directly influenced by visitors. They occupied two major colonies, approximately equal in size, each consisting of many subcolonies, clustered at either end of the landing beach (Map 7.3). It appears that this population has increased several-fold since the early 1970s and has continued to increase since tourists started visiting the island (Nimon, 1997). Small numbers of chinstrap penguins (37 pairs in 1971 and only three in 1986) had previously been reported to breed on Cuverville Island (Croxall and Kirkwood, 1979; Poncet and Poncet, 1987), but none did so during the study period reported here.

Map 7.3 The Northwestern shore of Cuverville Island, including the Northwest and Northeast Colony.



From early in the 1992/93 season access to Northwest Colony (Map 7.3) was restricted; there were minimal visits by researchers (two population counts at the start and end of each season), expedition leaders and tourists were requested to keep away from the breeding areas. All tour operators co-operated: in consequence, breeding birds in this colony received only a fraction of the attention given to Northeast Colony. Northeast Colony (Figure 7.2) was visited daily by researchers, and approximately every third or fourth day by parties of tourists. Ornithological research (see Sections 7.5–7.7 below) was restricted to a few of the subcolonies: the tourist parties moved mainly on clear ground forming convenient routes between the subcolonies (see 7.3 below). In the course of three seasons Northeast Colony was visited by over 8,000 tourists, while Northwest Colony received fewer than 30 visitors during the same period (Nimon, 1997).

In summary, gentoo penguins were one of the highlights for tourists visiting Cuverville Island. The birds breeding in the Northeast Colony were subjected to high levels of visitation and hence were perceived as being vulnerable to disturbance from visitors.

*7.2.2.2 **Skuas***

Cuverville Island is located within the geographical ranges of both brown and McCormick's skuas (Trivelpiece and Volkman, 1982). While brown skuas are generally described as larger and darker in colour, and McCormick's skuas are smaller with golden hackles (Watson, 1975; Trivelpiece and Volkman, 1982), hybridising produces birds that are intermediate in colour and size (Parmalee *et al.,* 1977; Trivelpiece *et al.*, 1980). Recent genetic studies indicate that the taxonomy of skuas in the southern hemisphere needs revision (Blechschmidt *et al* ., 1993).

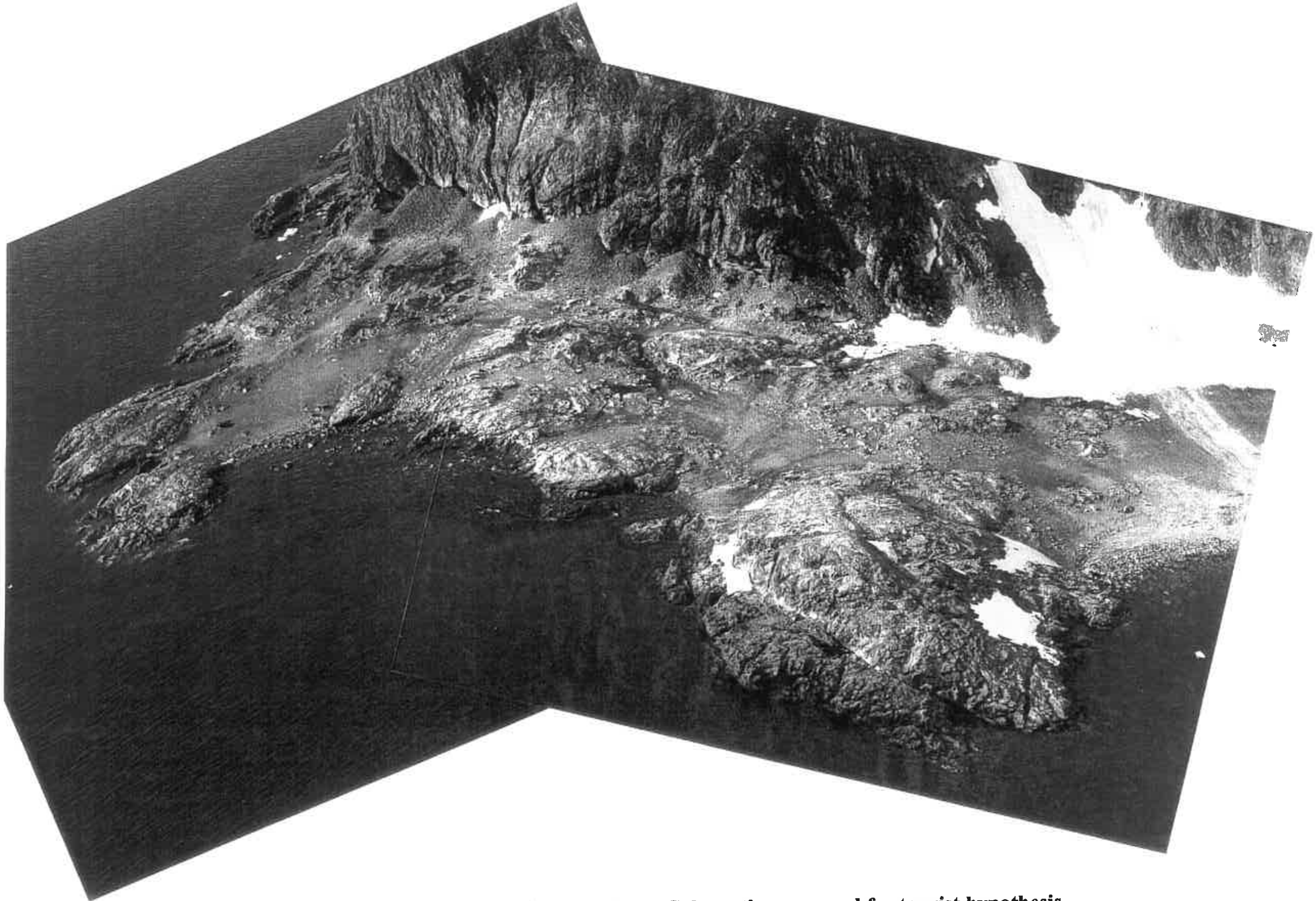


Figure 7.2 Oblique aerial photograph of the Northeast Colony, the area used for tourist hypothesis related studies. Photograph courtesy of the British Navy and Hydrographic Office.

Among Cuverville Island skuas, Stonehouse (*pers. com.*) identified a few McCormick's skuas, confined entirely to high ground above the landing area, and brown or hybrid skuas, of which, some bred on the high ground, and some in the landing area (see Map 7.2). All non-breeding skuas in the lowland areas were brown or hybrid. All the birds in this study were therefore identified as *Catharacta* spp., recognising a strong bias toward *C. lönnbergi* and hybrids. The increases noted in Table 7.2 can be attributed to improvements in census methods.

Of the skua pairs counted, most bred on high ground above the landing area, well away from normal influences of tourists or researchers: only once or twice per season did small groups of tourists, accompanied by guides, make the easy but time-consuming climb to the peak. Fewer than a dozen pairs nested in the landing area, mostly in the lower moss-peat banks or on rocky points. Except when counting, nesting areas were avoided by researchers, and few tourists climbed up to these lower moss-peat banks or rocky points. In consequence few interactions occurred between visitors and breeding skuas. Only three pairs of skuas fed regularly on Northeast Colony: Section 7.6 describes a study that examined whether tourist parties influenced skua predation on penguin eggs or chicks.

In summary, there were only three pairs of breeding skuas (3% of the population) which were perceived as vulnerable to disturbance resulting from visitation. The remainder were protected from direct interactions with visitors by the location of their breeding and feeding territories.

7.2.2.3 Dominican gulls

The Cuverville Island population of Dominican gulls bred mainly in a colony of between 42 to 50 nests (see Table 7.2) in the northeast corner of the island (Map 7.2). This site was only accessible on foot at low tide, and then not by an obvious route. No gulls nested on the landing beach: the remaining nests were found in isolation or scattered groups on moraines and screes along the east, south and west shores, and on islets in the western arm of Errera Channel. Breeding earlier than penguins or skuas, most had nests with eggs by the time researchers arrived in November, and some nests may already have been lost to intra-specific predation.

Although damaged penguin eggs were seen in their nesting area, gulls were not seen feeding on the colony: either they took eggs from other colonies, or they fed locally only until the arrival of the skuas in early to mid-December. No detailed studies of this species were conducted. However, it was noted that a pair of skuas nesting 15 metres from the gull colony appeared to predate heavily on eggs and chicks, possibly enough to account for the gulls' very low breeding success. Although human visits of any kind could have caused serious disruption to the gulls which appeared to be easily disturbed by people (see Section 7.5), neither researchers, nor tourist parties, visited the gull nesting areas: hence,the low breeding success recorded (Table 7.2) could be attributed to natural causes.

In summary, this species, although apparently vulnerable to disturbance (see also Section 7.5), were largely protected from tourists by the geographic location of their colony.

7.2.2.4 Antarctic terns

Like Dominican gulls, Antarctic terns were especially timid and easily disturbed (see Section 7.5). An estimated 25 pairs concentrated on the seaward side of the mound close to the middle of the landing site (see Map 7.2), with two or three pairs noted annually nesting in isolation along the shore of the island. Census of the main colony was completed by counting Apparently Occupied Nests (birds sitting tight and apparently incubating) (Bibby *et al.*, 1992) from a vantage that enabled a complete view of the gull colony. Once the colony had been recognised and counted, researcher activity at that site was minimised. Physical constraints protected these breeding areas from tourist visitation. The colony, however, was subject to constant disturbance and predation by skuas, one pair of which nested close by. Therefore, although, like the gulls, this species would be extremely vulnerable to tourist incursions if more accessible, the low breeding success of this particular population (see Table 7.2) can be attributed to natural causes, most likely skua predation.

In summary, although the breeding colony of terns was apparently easily disturbed (see also Section 7.5), it was at least partially protected from visitor disturbance by the location.

7.2.2.5 Sheathbills

Small stable numbers of sheathbills (Table 7.2) nested in the area each year, choosing sites close to the penguins, gulls, terns and blue-eyed shags and scavenging on the colonies. They appeared more timid than others that have been reported further north, for example on South Georgia and the South Shetland Islands (Stonehouse, *pers. com.*): where they have been reported to visit stations or follow human visitors. They were occasionally seen scavenging on the penguin colonies, but appeared to take most of their food from elsewhere. The four or five pairs were also counted on the basis of Apparently Occupied Nests (see Section 7.2.2.4): these nests were distributed around the island coast. Although reasonably sure of the numbers of nests, the number of chicks raised is unknown.

The very few pairs of sheathbills at this site did not appear to be vulnerable to disturbance from visitors, as the only nest located in the landing area was in a section visited only infrequently.

7.2.2.6 Blue-eyed shags

Blue-eyed shags nested in two neighbouring colonies close to sea level on the eastern shore of the island, well away from the landing site (see Map 7.2). They could be approached closely by Zodiac, although landing at this point would be difficult, and tour groups are unlikely to attempt it. Shags from these colonies were usually to be seen feeding in Errera Channel. It was not possible to determine why the colonies showed a slight, progressive decline during the three seasons, although their location suggests that direct human contact was not a contributing factor. However, blue-eyed shag populations are known to be subject to large inter seasonal fluctuations which are thought to be related to food sources (SCAR-BBS, 1996) .

Because of the location of their breeding colony these birds were not exposed to tourists, and hence were not perceived as vulnerable to tourist disturbance.

7.2.2.7 ***Petrels***

Although the island supported a large population of Wilson's storm-petrels, the number of Cape and snow petrels was low: The population increases seen across seasons (Table 7.2) result from additional nest sites being located during the 1993/94 season. Many cape petrels and fewer snow petrels were often seen flying around the mountains forming either flank of Errera Channel, most notably Spigot Peak at the northern entrance, and unnamed peaks along Arctowski Peninsula. In comparison, Cuverville Island was a very minor breeding location. Cape and snow petrels nested well away from tourist routes, in areas inaccessible to most visitors. A few Wilson's storm-petrels nested in screes along the beach, and late evening and early morning visitors sometimes found them fluttering close at hand.

Of the petrel species, visitors only had access to areas where Wilson's storm-petrels were nesting. It was not possible to determine whether this interfered with their breeding.

7.2.2.8 Seals

Weddell, leopard, elephant and Antarctic fur seals were found ashore at Cuverville Island occasionally, and crabeater seals were frequently seen on ice floes close inshore. If seals were using this area for breeding purposes this would occur in early spring before the arrival of either researchers or tourists: Weddell seals hauled out in small numbers at the point of the island closest to Rongé Island (Map 7.1). Crabeater seals were sighted on floes in Errera Channel, but only once during three summers was one seen ashore. Leopard seals hunted penguins in the bay north of the island, but again only one was ever seen ashore. Southern elephant seals were infrequent visitors in late January and February. In general, tourists rarely came into contact with phocid seals ashore on Cuverville.

Antarctic fur seals visited regularly from mid-January onwards, usually in groups of up to 20 young males, gathering in particular on the beach area west of the Northwest colony (see Map 7.2). In previous seasons up to 50 Antarctic fur seals had been seen by Charles Swithinbank and Angus Erskine (*pers. com*, 1993). At Georges Point, Rongé Island, during visits in late summer of 1994 and 1995, over 150 Antarctic fur seals were recorded ashore. This suggests that the presence of the field station may have dissuaded Antarctic fur seals from using this beach.

Little is known yet of how seals respond to humans. Phocids generally appear little disturbed by humans who approach slowly: young male Antarctic fur seals often show aggressive behaviour, which quickly subsides if the visitor withdraws.

Seals on Cuverville Island had virtually no interactions with tourists, and as such were not percieved as vulnerable to disturbance at this site. No further studies were made.

7.2.3 Historical artefacts

No historical artefacts have been documented previously on Cuverville Island. However, several artefacts from the whaling period, including a large anchor chain on one of the islets, for mooring a whale factory ship in the narrow western arm of Errera Channel, and the remains of a small water boat on the same islet were identified by the research team. When the snow disappeared from the western end of the landing beach, the remains of a small dam, built to collect fresh water, presumably for the whaling factory processes, was located. These findings suggest that Errera Channel was used as a harbour and factory site, or as a satellite factory site for the Neko Harbour site (Tønnessen and Johnsen, 1982).

The points of historic interest, although an added attraction, were not perceived as being likely to be disturbed by tourist visits.

7.2.4 Summary of resources

From these basic studies cataloguing the island's natural and human resources, we drew the following conclusions:

- The Cuverville Island landing site is rich in vegetation and birds, less so in seals.
- While the island supports unusually dense moss beds, these were located mainly on steep north-facing slopes, virtually inaccessible to visitors. The abundant *Polytrichum* sp. suffered severe disturbance and natural scarring through waterlogging and slipping, but showed evidence of recovery from this natural damage.
- Of the nine species of seabirds found to breed on the island, gentoo penguins and skuas were most in evidence and accessible to tourists, each with nests in the main landing area. Neither species showed immediate signs of being affected by tourist visits.
- Two species of flying bird , Dominican gulls and Antarctic terns, nested close to the landing site, but were, to some extent protected from tourist movements by local topography. Had they lived closer, they would almost certainly have been at risk from disturbance. Both species suffered severe predation or interference, apparently from skuas.

- Sheathbills, shags and Wilson's storm-petrels nested within reach of tourists but showed no signs of disturbance from tourist activities. The small numbers of cape and snow petrels nested remote from any possible interference.
- Seals hauled out in areas where human contacts were rare and incidental.
- A number of historical artefacts from the whaling period, concentrated at the western end of the landing beach, show that the area may have been used by whalers as site for a moored factory ship.

7.3 Use of the landing site by shipborne tourists

Visitor use of the island was recorded throughout the three seasons of study. Data consisted of a log of all ship and yacht visits, and records of numbers coming ashore at each visit (see Appendix 6). The spatial diffusion of visitors over the landing site was also examined, to establish which areas were used repeatedly, and which were subject to the highest densities of visitors. This information is useful for site-specific management recommendations, in indicating what visitors find interesting in the site, and where visitors and wildlife may come into conflict (Davis, 1995): in more general terms it provides patterns of visitor behaviour useful in considering management of other landing sites

7.3.1 Methods of study

In the 1993/94 season a study area, was defined to include the Zodiac landing points, research station, and northeast colony (see Figure 7.3). The study area was divided into irregular polygons (Map 7.4). These polygons were identified as B – Y and varied in size. Differences in sizes occurred because in the field the polygons were identified by distinct topographical features; no field markers were used to avoid influencing visitors movements. Observations were made from a hillside overlooking the study area (Map

7.4, Observation point). While tourists were ashore, observers recorded the numbers of visitors (both passengers and staff) in each polygon at five-minute intervals. This work was a pilot study for a more complete investigation in the 1994/95 season, when tourist movements were plotted for a total of 25 landings. The results presented here are from the 1994/95 study.

Of the 25 visits monitored in 1994/95, nine were made by three separate vessels which carried up to 50 passengers, eight were made by two vessels that carried between 50 and 80 passengers; and eight by four vessels that carried more than 80 passengers. In all, the movements of over 1500 visitors were recorded. Table 7.3 summarises the distinguishing features of the polygons, and the mean number of visitors for each during the whole season.

Also recorded during each visit were two weather parameters. These constituted air temperature in degrees celsius (from -1°C to +7°C) and cloud cover in octas (0 to 8, the latter being full cloud cover); the number of passengers aboard; and the number of other sites that the ship had visited during the voyage to date (these last two were obtained from a responsible staff member) to test if these variables had any influence on the dispersion behaviour of passengers ashore.

Map 7.4 Areas Defined for Monitoring Spatial Diffusion of Shipborne Visitors

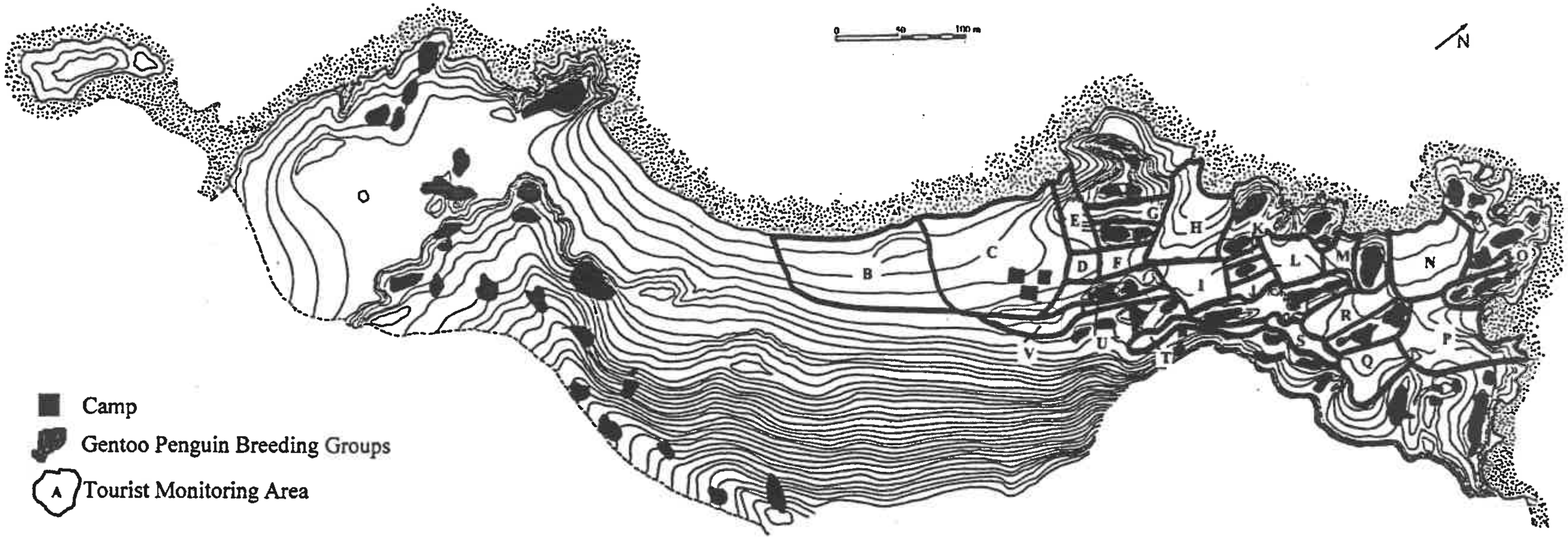


Table 7.3 Individual polygons: features and levels of visitor use. Those receiving more than 1.0 visitors per 5-minute period, and discussed in the text, appear in bold.

Polygon	Mean no. of visitors per 5-min. period	Standard deviation	Distinguishing features of polygon
B	**1.5**	4.95	Including the landing area
C	**11.84**	5.64	Including the research station
D	**1.65**	2.21	Routeway from station to penguin colony
E	0.45	1.10	Hillside away from main penguin colony
F	**7.81**	6.24	Penguin observation point closest to landing point
G	0.77	1.18	Area in which observer was counting
H	**8.79**	5.64	Beach area bordered by penguin breeding groups
I	0.27	0.46	Narrow pathway between subcolonies
J	0.19	0.28	Narrow pathway between subcolonies
K	**1.15**	1.7	Narrow pathway between subcolonies
L	**2.71**	2.69	Wide area bordered by nests on raised ground
M	**1.31**	1.09	Small beach area sloping down to shore
N	**2.75**	3.91	Beach area sloping down to the shore: whalebones,
O	0.18	0.35	Slightly raised area with slope to sea
P	0.43	0.57	Small sheltered cove
Q	0.51	0.96	Wide area: raised ledges with nesting penguins
R	0.11	0.21	Wide area: raised ledges with nesting penguins
S	0.11	0.26	Narrow path between cliff and rock outcrops
T	0.42	1.24	Narrow path between cliff and rock outcrops: hut
U	0.27	0.62	Path between outcrops with penguin nests
V	0.03	0.09	Slope behind rocky outcrop with penguin nests
W	0.02	0.07	Steep snow-covered slope to east of gully
X	0.02	0.09	Steep snow-covered slope to west of gully
Y	0.73	3.66	Route to top of hill

7.3.2 Results and discussion

Tourists were landed from Zodiacs in groups of 10 to 12 people at a single landing point in area B (Map 7.4). Only rarely, when brash ice accumulated around this point, was use made of the alternative site in area N. From either point, they explored the landing site by 'controlled wandering', i.e. supervised by staff but not deliberately led in groups. In practice very few deviated from a standard route through deep snow that became established early in the season, initially by penguins traversing between colonies and breeding groups. After the snow had disappeared, groups continued to follow the same route over the cobbles and pebbles of the beach, following the physical features exposed, which formed a slightly wider 'routeway' (Figure 7.2). Despite the island having been subjected to a known 136 landings (approximately 11514 visitors) between 1989/90 and 1994/95 there was no discernable erosion along the chosen route.

Most visitors quickly vacated area B in the direction of the station, thereafter following each other successively through areas D, F, H, K, L, M and N (Map 7.4). Area C, containing the research station, received by far the highest number of visitors. Area D included the obvious routeway from the station to the first point at which penguins could be seen and photographed. This point was contained in area F, the third most heavily-used polygon. From there, most visitors wandered to adjacent area H, a wide, gently sloping stretch of beach about 80 metres by 50 m, with space for visitors to spread out among breeding groups without getting in each other's way or infringing codes of conduct. This, the second most popular area, became the turning point back towards the landing site for many visitors, especially during bad weather.

Those visitors who dispersed further, tended to move from area H through K to L, M and N, where again they could spread out, dawdle, enjoy the scenery and examine scattered whalebones from the early twentieth century whaling. Most then returned along the same path to the station, and back to the landing point. At both the station and the camp, visitors could wait for Zodiacs to take them back to the ship.

These nine identified polygons were the only ones in which the mean number of visitors per five-minute period exceeded one. The number in the remaining polygons, ranged from 0.02 to 0.77, indicating that much of the study area was visited only rarely by tourists during each ship visit. During November and December, visitors were apparently often reluctant to strike through untrodden snow, which still lay thickly on either sides of the path. Later in the season, they seemed satisfied to follow each other along clear routes which, although unmarked, led them to interesting areas of the penguin colony and good vantage points for photography. Of the little-used areas, the two most popular were G, where the observers could be seen and questioned, and Y, crossed by an occasionally-used route taking guided parties to the top of the hill.

Thus from these initial findings it was possible to establish that visitors followed a set route, seemingly dictated by physical features, that varied little according to the presence or absence of snow. It was also possible to conclude that the functional aspects of the polygons (e.g. penguin breeding groups or camp) affected distribution and, on the basis of the concentration of visitors, those features of greatest interest appeared to be the camp and the penguin breeding colonies closest to the landing point.

For each visit, the degree of dispersion over the study area was derived by:

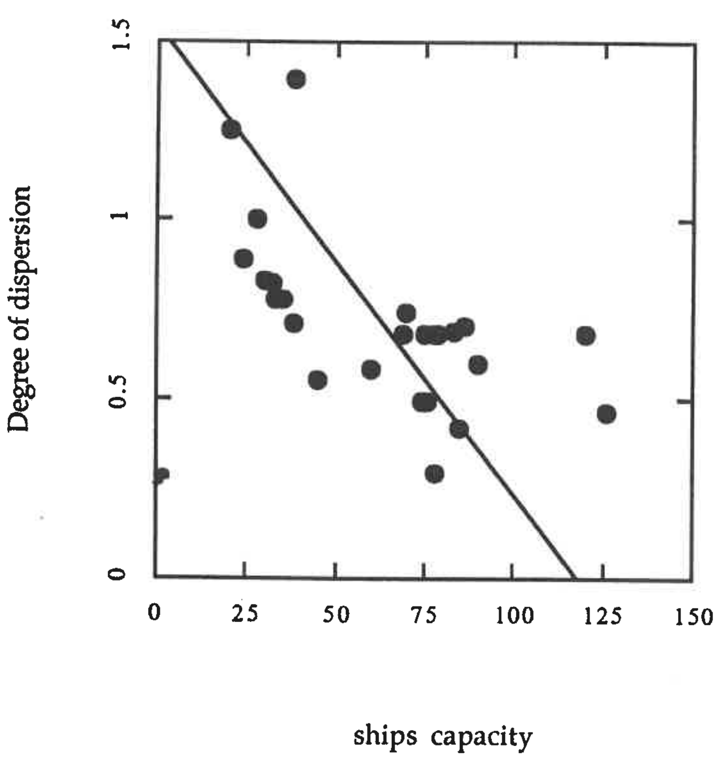
$$n = \frac{x \times y}{z}$$

where x is the number of polygons entered, y the mean number of visitors in each polygon, and z is the total number of passengers landed. Dividing the dispersion by the number of passengers landed normalised the data for the purposes of comparison between landings.

The degrees of dispersion varied from 0.28, (indicating that visitors were concentrated in a few polygons) to 1.39, (visitors spread widely: mean = 0.71, standard deviation = 0.24). While temperatures, precipitation and wind were recorded, it was not possible to examine the relationship as the range of weather conditions were not widely varied (temperature ranged from 0° to 7°C, mean temperature was 3.4°C, SD=1.6°C), nevertheless the weather experienced during the study period was typical of weather in the Northwestern Peninsula. No significant correlation occured between the number of sites previously visited, again because of a lack of variation between variables. The only significant relationship ($p = <0.01$) was with the total number of passengers ($r = -0.628, \pm 0.121$: Figure 7.3): as the group size decreased, the level of dispersion increased .

There are several possible explainations for this relationship. The smaller ships were primarily the converted Russian ~~previously~~ research vessels. The operators of these vessels emphasise the adventure aspect in an '*atmosphere onboard* [that] *is relaxed and informal*'... ...*we travel with a small group never overwhelming the places* *we visit*' (Quark Expeditions, 1996:6) It is quite possible therefore, that these vessels attract more adventurous tourist, who prefer not to travel or explore with large groups. Furthermore, on the smaller ships there is often a higher guide to passenger ratio ashore (for example one guide to eight to ten passengers, while on larger ships it is often in the region of one guide to 15 to 20 passengers). Unsurprisingly, a high guide to passenger ratio is more efficient and enables wider areas of the landing site to be covered in a short space of time.

Fig 7.1. Relationship between group size and visitor dispersion



7.3.3 Discussion and conclusions

These results must be assessed with information about landings in general, and tour operators' perceptions of Cuverville Island in particular, gained by PAC researchers while working as lecturers, guides and expedition leaders on cruise ships. In particular:

1. Each landing site is regarded by expedition leaders as providing a particular attraction, or a set of experiences for passengers: these are emphasised in pre-landing briefings (see Section 6.5).
2. Although passengers are theoretically free to wander widely over landing sites, they are, expecting to seek certain objectives or experiences at each site. Once these have been achieved, less adventurous passengers may return quickly to the comfort of the ship, leaving the more adventurous to seek other experiences.
3. The attractions at Cuverville Island most often cited by expedition leaders were (a) the gentoo penguin colony — probably the largest known, (b) the unusually beautiful setting at the head of Errera Channel, and (c) during the study period, the presence of the camp.
4. During PAC's three seasons of work on the island, expedition leaders encouraged tourists to visit the research station, and talk to the residents. Given the opportunities also offered by the research station for buying patches, T-shirts and other souvenirs, the station became a third attraction that attracted some passengers more than the penguin colony.

It was, thus, not entirely surprising to find that passengers, well-briefed but under minimum field guidance, made relatively small use of the site. During the first half of the season, the thick snow cover provided a powerful restraint: it was difficult and uncomfortable for any but the most able-bodied to plough through thigh-deep drifts. Even the walk along well-trodden paths proved too much for some, who visited the research station but no further. However, during the second half of the season, when more of the beach was available for wandering, passengers still tended to follow each other along a relatively limited number of possible pathways, and to be ready to return to the ship after visiting the research station and penguin colony.

This observation compares with PAC findings at another popular landing site: Hannah Point, Livingston Island, South Shetland Islands. In a study of nine visits by five ships, Davis (1995a) found that tourists spent 40% of time ashore in the zone closest to the Zodiac landing point, which included items of interest (chinstrap and macaroni penguins) specified in the pre-landing briefing.

Thus this study suggested the following conclusions:

- Visitors to Cuverville Island, although free to wander widely over an extensive landing site, used only a very limited area.
- The main areas visited contained those features cited in their pre-landing briefing, and few visitors ventured further.
- The Zodiac landing point, the station and accessible parts of the gentoo penguin colony were the most popular areas for visits.
- In November and December, deep snow apparently restricted visitors' movements, confining them to relatively narrow pathways between the landing point, the research station and the penguin colony.
- In later summer, although absence of snow gave them opportunities to wander more widely, they still tended to remain in the same areas.
- There was a significant correlation between the degree of dispersal and the size of the visitor group: visitors from ships with small carrying capacity tended to wander more freely than those from large ships.

7. 4 Recovery rates of moss species from footprints

Vegetation grows slowly in Antarctica. For this reason, it has been considered as likely that damage to vegetation due to trampling is likely to remain evident for an extreme length of time or forever (Benninghoff and Bonner, 1985, Smith, 1996). On Cuverville Island vegetation grew in unusual abundance, yet there were no extensive moss flats that were at risk from tourist visits. However, because the vegetation was abundant with extensive patches of several different species of moss, it was perceived as an appropriate site to assess species recovery rates from a single footprint. Thus, Weinstein in 1993/94 initiated a pilot programme of research on recovery from damage by footprints in five species of bryophytes.

Moss species selected were those found growing on flat, firm ground in areas of up to 2 metres^2. A single footprint was placed in each area under normal conditions (i.e. when the moss was not frozen over or excessively water-logged) and marked with small stakes. Each print was photographed immediately and subsequently at weekly intervals for the remainder of the season. Weinstein (1994) found that the degree of damage and recovery was species-specific. Footprints in *Brachythcium* spp. and *Drepanocladus* spp. remained distinct, with little apparent recovery, for over a month. Similarly-imposed prints in *Polytrichum* spp. were barely discernible immediately after they were made, and very difficult to see after 32 days (Weinstein, 1994). Both *Brachythcium* spp. and *Drepanocladus* spp. prefer a habitat of moist soil in depressions, exposed to continual irrigation by melt streams or melting snow (Smith, 1997). *Polytrichum* spp. prefer well-drained habitat, often on slopes where they accumulate deep moss-peat beds (see Section 7.2.1). *Polytrichum* spp. also have thicker strands than either *Brachythcium* or *Drepanocladus* spp. (Fenton and Smith, 1982). This implies that moss species which prefer areas that are inherently damp or water-logged are more susceptible to damage, while those species which are well drained and able to build up deep peat layers underneath are more robust. Hence, Weinstein's results suggest that species characteristics and habitat influenced the degree of damage caused by footprints.

Elsewhere in Antarctica another ~~further~~ PAC pilot study, established on extensive moss flats at Hannah Point (Stonehouse, 1995), drew attention to the damage inflicted annually by seals, gulls and other users. Observations there also suggested that substrate is at least as important as drainage in determining degree and persistence of damage. Further investigations of the relationship between recovery from trampling and substrate are planned in long-term studies at Arctowski Station.

7.5 Studies of flying birds

Overt indications of alarm by colonial nesting seabirds and waterfowl have been used as indications of disturbance by visitors in other regions of the world (Burger and Gochfield 1983, 1993; DeMauro 1993; Klein, 1993; see also Nimon, 1997). Attention has focused on 'flush' responses as a means to assess a safe approach distance (Burger, 1981; Erwin, 1989; Burger, *et al.*, 1995). These studies have indicated that certain species react more readily than others to intruders, and are thus more vulnerable to disturbance (Manuwal, 1978; Erwin, 1989; Burger and Gochfield, 1991). In Antarctica, studies of bird responses to the presence of humans has concentrated primarily on penguin species (Ainley, 1974; Wilson *et al.*, 1990), only secondarily on flying birds, with special emphasis on how the presence of humans influences feeding behaviour in skuas, sheathbills and giant petrels (Baker, 1973; Müller-Schwarze and Belanger,1978; Hemmings, 1990; Wang *et al.*,1996). Responses of individual species in Antarctica to human intrusion are anecdotal. However, only one study to date, has attempted to define quantative differences in the reaction of individual species of flying birds to human visitors (Peters, 1996)

During the 1993/94 season on Cuverville Island a pilot investigation of tolerance and response distances in four species of flying birds (Dominican gulls, Antarctic terns, blue-eyed shags and skuas) was conducted. Because of the low breeding success already recorded in Dominican gulls and Antarctic terns, and the slight decline in numbers of blue-eyed shags, the study was kept to a minimum to ensure only short-term disturbance. The experiments were conducted on still, relatively warm days, when exposure of eggs and chicks would be unlikely to affect breeding success.

The three colonial-nesting species (Antarctic terns, blue-eyed shags, Dominican gulls) were subjected to three sets of approaches to their colonies by two intruders in drab clothing. The intrusions were made three days apart during incubation or early brooding (mid to late December). Five individual skua nesting territories were similarly approached: their territorial boundaries were defined by observing from a distance the point at which they started defending their territories against conspecifics, Dominican gulls or human intruders. For each species, observations began as soon as the colony or nesting territory came into the intruders' view (distances varying from 30 to 15 metres see Table 7.4). Intruders approached slowly, pausing for one minute at each 5 metres, continuing to a distance of 5 metres from the colony's peripheral nests: there they paused for five minutes, then retreated slowly and continuously until out of sight of the colony. Table 7.4 details the responses of each species.

Blue-eyed shags made no overt responses until the intruders were 5 to 10 metres away. At 10 metres, the adults on eggs or chicks turned to face the intruders. Individuals gave defensive calls and displays of bill-lungeing, which continued so as long as the visitors remained, and ceased as soon as they began to retreat. None of the birds left their nests.

Table 7.4: Flying bird species response to human approach

Species	**Response distance**	**Reaction behaviour**
Blue-eyed shags	5 – 7 metres	Remained on nest: gave alarm calls and aggressive lunges, spread wings. Did not leave nest.
Skuas	10 – 15 metres (on perimeter of territory)	Incubating bird gave alarm calls: partner investigated, attacked by defaecating and with feet. At 5 to10 metres attacks intensified, sometimes both partners involved. Settled quickly when intruders left territory.
Antarctic terns	On coming into view of colony (c. 15 – 25 metres)	Unoccupied birds gave alarm calls, overflew, quickly joined by partners: swooped, attacked by defaecating and in-flight pecking. Continued circling as intruders retreated
Dominican gulls	On coming into view of colony (c. 30 metres)	Unoccupied birds gave alarm calls, overflew, joined by partners: swooped, attacked by defaecating. Continued circling as intruders retreated.

Skuas responded as soon as the intruders reached the boundary of the nesting territory, usually by an alarm call from the incubating bird, and an investigatory or attacking flight by the partner. Closer approach to within about 10 metres of the nest elicited intensified attacks, one or both partners swooping, defecating, and hitting the intruders with lowered feet. In a total of 15 approaches, nine resulted in attacks by a single bird, six by both partners. Attacks continued so long as the intruders remained in the territories.

Antarctic terns and Dominican gulls responded by concerted colony-wide action. As soon as the intruders came into view, all non-incubating birds rose with alarm calls and circled toward them. As the intruders continued their approach, alarm calls intensified and the birds swooped close overhead, sometimes dropping faeces or part-digested food: most incubating terns and many incubating gulls also left their nests to join in. Terns intensified attacks further by attempted pecking of intruders. Alarm calls and attacks continued as the intruders retreated, and for as long as they remained in view of the birds. During the retreat, gulls returned to their nests more readily than terns.

The study did not take into account possibilities of habituation (reduction or loss of response to a stimulus resulting from repeated stimulation without negative consequences: Lincoln *et al.*, 1982), which may be expected to occur to varying degrees in species that are repeatedly subject to human approaches, and is an important consideration for management. Although Cuverville Island was (and remains) among the most frequently visited sites (Appendix 5), its shag, gull and tern colonies, and all but a few pairs of skuas, are remote from direct visitor disturbance (Section 7.2.1). Habituation is thus unlikely to be an important issue for flying birds at this site, except perhaps for skuas. To study habituation would require a different approach to that possible in this preliminary study.

These observations illustrate that, like gull and tern populations elsewhere in the world (Krury,1975; Burger, 1981; Erwin, 1989) Antarctic terns and Dominican gulls are acutely sensitive to human disturbance. While their rapid response to seemingly minor of threats (for example, the approach of humans) may be effective in defending nests from ground intruders, in the Antarctic environment the flight response clearly leaves nests and their contents vulnerable to chilling, and possibly also to attacks from skuas. In comparison, the reluctance of skuas to leave the nest until intruders are close, and the nest-holding responses of shags, renders offspring less vulnerable to human disturbance in this cold environment.

Skuas are known to be opportunistic and rapid learners (section 7.6), quick to habituate. They have maintained high breeding densities and breeding territories close to human activity (Stonehouse, 1956; Young, 1990, 1994; Hemmings ,1990; Wang *et al.*, 1996). As such, they are almost certainly less vulnerable to human disturbance than the other three species. In contrast, our knowledge of the breeding biology, abundance and distribution of Dominican gulls and Antarctic terns is extremely limited (SCAR-BBS, 1996), and further research into implications of human disturbance, including possible habituation, is clearly required. Meanwhile there is good reason to regard these species as particularly vulnerable to human intrusion, especially on cold days during incubation and early brooding when chances of chilling the offspring are high.

7.6 Skua-penguin interactions and human activities

Skuas are versitile and opportunistic feeders (Stonehouse, 1956; Ekland, 1961; Llano, 1971; Müller-Schwarze and Müller-Schwarze, 1977; Young, 1994). Increases in skua predation on other bird species as a result of human interference have been documented (for example, Kury and Gochfield, 1975) as have incidents of skuas optimising from disturbance of prey (Stonehouse, 1956). The dramatic increase in tourism to the Antarctic has prompted speculation that the presence of tourists at a penguin colony could cause enough distraction to increase the vulnerability of the colony to predation (Soper, 1996:7; Giese, 1996:162).

On Cuverville Island, a study was established to assess whether tourists in the gentoo colony contributed to opportunistic predation by the five pairs of skuas that held feeding territories there. Despite the large number of skuas breeding on Cuverville Island, only three pairs fed regularly in Northeast Colony (Map 7.3), and a further two in Northwest Colony. This is not unusual: similar percentages of the skua populations at Cape Crozier (Müller-Schwarze and Müller-Schwarze 1973) and Cape Royds (Young 1963) fed in the local penguin colonies.

Two neighbouring feeding territories on Northeast Colony, each occupied by a pair of brown or hybrid skuas, were selected for monitoring from a vantage point (Map 7.3). Each territory contained breeding groups of between 20 and 200+ penguin nests, totalling about 2000 pairs, and each was subject to frequent tourist activity (Section 7.4). A team of observers took turns to watch and record skua activity for two-hour periods each day in consecutive cycles from 0600 to 2000 (within the time span that tourists landed at the island), restarting at 0600 to 0800 at the end of each cycle (a method based on Emslie *et. al.* 1995). Additional observations were made during tourist ship visits, when tourists moved around the periphery of the penguin breeding groups. Observers sat on a hillside near the edge of Territory 1, approximately 150 metres from the territory owner's nest, using 8 x 40 binoculars for a clear view over territories and skua nests.

Table 7.5 : Behaviour categories used to define Skua foraging behaviour in feeding territory.

Behaviour category	Code	Definition of behaviour
Search air	SA	Slow, wheeling flight over the territory, often provoking no response from the penguins
Search ground	SG	Searching along edge of breeding groups, sometimes pausing. Occasionally provoking a defensive response from the penguins
Attempt air	AA	Unsuccessful predation from flight
Attempt ground	AG	Unsuccessful predation from a ground position
Predation air	PA	Successful predation from flight
Predation ground	PG	Successful predation from a ground position
Scavenge	S	Feeding on spilled krill, abandoned eggs or carrion without initial aggressive behaviour towards the prey

No hide was used, and at no time were the skuas handled or fed, nor were their nests approached. They may have habituated to the presence of the observers; none of the birds showed curiosity over their presence. Both pairs displayed courtship-feeding and fed chicks near the nest, behaviour that both Young and Stonehouse (*pers.com.*) deem indicative of non-disturbance.

Monitoring began on 15 December 1994 and continued until 15 February 1995, a period covering the penguin breeding cycle from laying to crêching. Observations of skua and penguin interactions totalled 28 one-hour watches with tourist visitors present, and 68 two-hour watches when tourists were absent. Resident skuas were identified by eye. Behaviour was recorded according to categories based on Young (1970, 1994) and Emslie (1995): see Table 7.5. The presence of interloping skuas, gulls, giant petrels and other predators was also noted. Rates of predatory activity in either feeding territory were calculated as the number of events (search flights, attempts, predations) per hour of observation.

Table 7.6. Rates of skua foraging activity during periods with and without tourist visitors.

Behaviour	Rates of activity with visitors present (and SD)	Rates of activity with visitors absent (and SD)
Ground search	2.3 ± 1.19	2.6 ± 3.34
Air search	3.9 ± 1.63	5.25 ± 2.47
Scavenge	0.5 ± 0.37	0.29 ± 0.35
Attempt predation from air	0.08 ± 0.08	0
Attempt predation from ground	0.28 ± 0.35	0.25 ± 0.35
Predation from air	0.12 ± 0.11	0.17 ± 0.38
Predation from ground	0.21 ± 0.13	0.25 ± 0.44

In this study 91% of all predatory events on and over the penguin colony were due to the territory-owning skuas. The remaining 9% were due to Dominican gulls (3%) and interloping skuas (6%). As found in previous studies (Müller-Schwarze and Müller Schwarze, 1977; Young, 1994; Emslie, 1995), a large proportion of predatory activities occurred at the periphery of penguin breeding groups, 92% when tourists were absent and 95% during their visits. Rates of the different predatory activities (Table 7.6) during visits and control periods were compared to assess whether rates of predator activity were higher when visitors were in the breeding territory. It is clear from the results in Table 7.6 that this was not the case. Skua behaviour patterns under the two conditions were further assessed using Kendall's rank correlation: a very strong relationship ($T = 0.93$, $p = 0.002$) indicates that overall behaviour patterns varied very little according to the presence of visitors.

The skuas used in this study occupy nests in one of the most frequently visited sites in Antarctica (an average of one visit, with 70 tourists every three days), hence if the penguins on Cuverville Island were sufficiently disturbed by visitors in a manner affording opportunity to skuas, it would be reasonable to expect the skuas to have learned to capitalise on this. Given that Nimon (1997) found that incubating gentoo penguins did not stand nor flee, even when approached by 50 people to a distance of five metres, it seems safe to assume that, at least at this site, tourist activity does not enhance skua predation. Thus, although this was a site visited by many tourists for several seasons, and the feeding territories were in areas subjected to high rates of visitation (Section 7.4), the resident skuas showed no evidence of having found the presence of human visitors either to their advantage or to their disadvantage.

7.7 Gentoo penguin responses to humans

There have been several studies on the influence of human activities on penguins in the Maritime Antarctic (Culik *et. al.* 1990; Culik and Wilson, 1991; Wilson *et. al.*,1991; Nimon *et al.*, 1995; Fraser and Patterson, 1997; Nimon, 1997), in Vestfold Hills, East

Antarctica (Giese, 1996) and in the Ross Sea region (Wilson *et al,* 1990, Woehler *et al.,* 1994). Of these only two, those of Nimon (1997) and Giese (1996), measured specifically the effects of tourist behaviour on penguin breeding success: the rest measured responses to more obtrusive disturbance of penguins, such as building stations near or on penguin colonies, or directly handling and manipulation of birds.

On Cuverville Island Nimon, Schroter and Stonehouse (Nimon *et al.,* 1994, 1995) measured responses of incubating gentoo penguins to humans by monitoring changes in heart rate, using artificial eggs containing sensors. These did not require the birds to be handled or traumatised, and gave more direct measurements of immediate responses to visitors than hatching success and chick survival. Nimon measured the responses of several incubating birds to such naturally-occurring stimuli as other penguins approaching the nest, stone-stealing, and predatory skuas overflying or approaching the nest. She then measured responses to human visitors, singly, in groups of one, three, and 15 or more, approaching slowly or quickly, approaching to five metres (the IAATO-recommended range) and closer, etc.

Nimon (*et al.* 1995; 1997) found, that a group approaching to five metres elicited an increased rate, which returned to normal when the group stopped, and increased again momentarily when they retreated. A single visitor approaching slowly to three metres caused little or no change in heart-rate: a combination of brisk approach and close proximity to the nest however caused a steep increase, which did not subside until the visitor had retreated, and returned to normal only when the visitor was out of sight. Changes in heart-rate due to movements of human visitors about the colony were generally less than those caused by movements of other penguins and skuas. On the basis of these results, Nimon suggests that enhancement of the guidelines to the extent of observing the minimum approach distance of five metres, avoid brisk walking or boisterous behaviour and minimising the number of approaches to breeding groups, with small groups of visitors, would ensure very little adverse effect on nesting gentoo penguins, particularly when compared with everyday natural disturbances.

This technique of monitoring through artificial eggs is limited in application to nesting birds. It does not address the possibility, raised long ago by Stonehouse (1965), that a steady decline of numbers in a frequently-visited colony is likely to be due to interference, not with nesting birds, but with immature birds seeking nest sites close to existing nests. These are often disturbed by visitors who, while scrupulously maintaining their distance from incubating birds, feel less protective to the non-breeding, 'play-nesting' bird on the periphery of the colonies, thus disturbing the birds such that they move to a different area.

As a further check on the possible effects of disturbance, Nimon (1997) compared breeding success in the two major breeding colonies, Northwest and Northeast (Section 7.1.1) during our 1993/94 and 1994/95 seasons. Northwest Colony, maintained as a control, received very few visits — an estimated 16 hours each season by station personnel, virtually none from tourists. Northeast Colony, visited constantly by researchers and tourists, received an estimated total visitation of 5350 person hours in 1993/94, and 6920 person hours in 1994/95. Breeding success, measured as number of chicks raised per nest, was 1.45 in both colonies in 1993/94: in the following season it was 1.22 in the disturbed colony and 1.19 in the control colony, a non-significant difference.

Nimon's findings run contrary to those of Culik and others (1990) and Wilson and others (1991), who monitored heart-rate in Adélie penguins by methods that subjected them to handling and instrumentation. Reporting that breeding birds showed dramatic avoidance reactions to pedestrians, and substantial increases in heartrate on approach by individual human visitors, they concluded that irrespective of how tourists behave their presence will affect breeding penguins (Culik and Wilson (1991). Nimon and others (1995) challenged this interpretation, mainly on the grounds that instrumented penguins are likely to induce associative learning and predispose birds to extreme reaction on subsequent sighting of humans.

Giese (1996) exposed colonies of Adélie penguins to two forms of human activity, nest checking for scientific purposes and recreational visits, and compared hatching success and chick survival with those at an undisturbed control colony.

Hatching success at a colony exposed to nest checking was 35% lower than in the control colony, and 47% lower in the colony subject to recreational visits. Chick survival was 72% and 80% lower respectively. All differences were statistically significant. Giese suggests that the low hatching success and chick loss were caused by skua predation.

These results may be taken to indicate that both scientific and tourist activities were detrimental to nesting success. However, they raise several questions when considered in relation to tourist visits. These were penguins that had previously been exposed to no human contact (Giese 1996:158), and they may have reacted more strongly to human interference than birds with regular exposure to human disturbance (Section 7.5): the important question of habituation to tourist visits has been raised by Nimon (1997) and by a number of other workers including Aguirre and Acero (1993) but this has not been studied in a systematic pattern. There is no indication of how penguin responses in Geise's (1996) study provided the skuas with opportunities to predate. Furthermore, it is not known if skua activity would have been greater in these groups had there been no experimental interventions: there is much evidence to suggest that rates of skua activity vary substantially between breeding groups and colonies (Müller-Schwarze and Müller-Schwarze 1973, K.Crosbie unpublished data).

Thus, although Giese's(1996) study disclosed behavioural responses of Adélie penguins that were to the best of her knowledge unhabituated, it cannot be regarded as indicating what occurs at penguin colonies subject to frequent tourist visits. Nimon's conclusions (1997) are further substantiated by Fraser and Patterson's (1997) report on long-term population trends for Adélie penguin colonies in the region of southern Anvers Island. The colonies compared included Litchfield Island (declared an SPA in 1978, and since visited rarely) and Torgersen Island, which had experienced a six-fold increase in tourist-related activities over 20 years and was used continually for research purposes. Both colonies declined during the period 1975–92, that on Litchfield Island by 43%, that on Torgersen Island by less than 19%. Fraser and Patterson concluded that, in this case, environmental variability was the key factor in penguin population changes, rather than human disturbance.

7.8 Discussion and conclusions

The three-season Cuverville Island study, the first long-term, multple investigation of the effects of tourist visits on an Antarctic landing site, presents useful indications for long-term management and monitoring programmes.

1. The first requirement is accurate identification, delimitation and mapping of the landing site. For other sites maps of the landing site and environs to a scale of 1:5000 might best be achieved by photogrammetry: however, adding detail to 1:1000 may require fieldwork and infilling from photography. In either case, draughtsmanship to professional standard is needed to produce dependable maps for management purposes.
2. At other sites, a first assessment and mapping of biological and other resources of the landing site could be made within a few days, and is essential for management purposes. Experience on Cuverville Island showed the value of longer studies, which added substantially to first assessments, revealing more fully the ecological complexities of the site, and provided a better basis for understanding interactions between visitors and biomes.
3. Monitoring visitor movements on Cuverville Island revealed that only a very small area of the site itself (approximately 20% of the total area) was used by visiting parties. The rest was ignored or visited only very infrequently. (While thick snow limited usage early in the season, reasons for self-restriction are less obvious after the snow had gone). Most visitors appeared to be confining themselves rigorously to salient points likely to have been raised in their pre-landing briefings. Cuverville Island was represented as the site for seeing (a) a large gentoo penguin colony and (b) a small research station, and most visitors were satisfied to return to the ship when those objectives had been achieved.

4. Wherever else they go during a landing, all visitors pass twice through landing points, which are clearly areas of heaviest visitation. It would be essential to any management plan that landing points be identified clearly, and for expedition leaders to be able to show, for record purposes, exactly where they landed.
5. Studies of vegetation showed mainly the dynamic qualities of the island's moss beds, and their capacity for rapid recovery by regeneration from seepage-induced slumping. Experimental studies of damage by trampling revealed only that different species of moss showed differing capacities for recovery, indicating the need for further studies at more suitable sites.
6. Observations on breeding stocks of flying birds showed a range of responses to human presence, indicating the extreme vulnerability to human interference of breeding Dominican gulls and Antarctic terns, the relative indifference of skuas, and the immunity of other breeding species that, while listed as present at a landing site, do not come directly into contact with visitors. Observational studies of skua predations on gentoo penguins provided no evidence that the presence of tourists influenced in any way the interactions of these two species.
7. Experimental research and observations on gentoo penguins, for the first time using non-invasive monitoring techniques, provided evidence that tourists who follow accepted guidelines in approaching penguin colonies are unlikely to stress incubating birds. No significant difference was found in breeding success between a well-visited sub-colony and one that received many visits from researchers and tourists.

Chapter 8
Monitoring tourist landing sites

8.1 Introduction

'... cumulative effects are probably the most ecologically devastating environmental effects. ... The interaction, combination and compounding of environmental effects over time and space may alter the fundamental structure and function of biophysical and socio-economic systems ... cumulative environmental effects are responsible for determining the health and the integrity of an ecosystem and will directly challenge the concept of sustainable development.'

Clark and Leppert-Stack (1994), cited in Dupois (1996:17)

A recent IUCN workshop on 'Cumulative environmental impacts in Antarctica (De Poorter and Dalziell, 1996), emphasised the importance of post EIA monitoring or auditing, particularly for the assessment of cumulative impacts. Nevertheless, although cumulative impacts, resulting from repeated visits of tourist parties, are the impacts most likely to affect landing sites, no attempts have been made to establish a landing site monitoring programme.

Landing sites are the point where tourists make direct contact with the Antarctic environment (Section 4.4.1). As the number of voyages each season has increased, the number of landing sites used and of landings made have increased commensurably (Section 5.4). Studies so far have revealed only minor impacts and disturbances (Chapter 7). However, short-term studies cannot address cumulative impacts, which are probably the most likely consequences of repetitive visits over the long-term (Section 4.4.1.4). There continues to be insufficient evidence available in order to determine whether current management practices are appropriate, or inappropriate, for long-term heavy usage. Thus the perceived need amongst Treaty Parties (Section 2.5.3) for the assessment and monitoring of the consequences of tourist activities remains pertinent.

This chapter reviews monitoring definitions, objectives and principles as defined in recent literature, including reports apposite to operations in the Antarctic, and assesses their applicability to monitoring tourist landing sites in the Maritime Antarctic. In doing so two problems arise: (a) the impact of tourism activities has not yet been fully identified, and are quite likely to be subtle and complex; and (b) disturbances are not confined to one static site for a continuous period, but vary over time and space (Minbashian, 1997). This creates logistical and methodological problems. Consequently, a monitoring programme for tourist landing sites will need to be devised within temporal and financial constraints, while data collection will need to be efficient and compatible with other sources and monitoring programmes. This chapter proposes guidelines to be considered in planning for monitoring tourist landing sites.

8.2Ecological monitoring: definitions, concepts and objectives

Ecosystems are prone to natural variations (Agee and Johnson, 1988). In the Maritime Antarctic these variations can be induced by: random occurrences such as volcanic activity; successional changes, such as the slow but significant alterations to the ecosystem following ice retreat; or cyclical influences, such as predator-prey relationships. Within the context of natural variation, monitoring enables the identification of any unacceptable alterations to ecosystems resulting from a specific human activity. Thus monitoring is now perceived as vital to all aspects of conservation (Abbot and Benninghoff, 1990; Goldsmith, 1991; Furness *et al.*, 1993) and the basis for environmental impact assessments (Bissett, 1984; Walthern, 1988; Stankey *et al.*, 1990; Spellerberg, 1994). This is almost certainly because, by definition, monitoring recognises the potential for change.

8.2.1 Definitions of monitoring

Recent literature has emphasised the importance of linking monitoring programmes to management strategies (Clark, 1986; Bisset and Tomlinson, 1988; SCAR and COMNAP, 1992, 1996). Monitoring allows managers to evaluate the situations they endeavour to control, and provides a means of assessing the success of management strategies. Thus, Hellawell (1991:2) defines monitoring for conservation as repeated surveys of a series of populations, based on a clear set of objectives that are usually tied to an environmental management strategy. In this form, monitoring can be used to assess the effectiveness of policies, audit impact assessments, and detect incipient change. Specifically, Spellerberg (1994) summarises the value of ecological and biological monitoring as follows:

- a means of establishing whether ecosystems and populations are being managed and conserved effectively,
- a means of assessing the best use of the land,
- an indication of the state of the environment, and
- advancing knowledge about the dynamics of the ecosystem.

8.2.2 Concepts of monitoring

Three aspects of monitoring were identified by Spellerberg (1994): *compliance monitoring*, *trend monitoring* and *hypothesis testing*. Compliance monitoring is designed to ensure that activities conform with the mitigation measures detailed in the management programme or environmental impact assessment. Trend monitoring is a means of identifying any large scale patterns in the activity or the environment in order to detect any variations which may occur, while hypothesis testing assesses specific perceived impacts. Although hypothesis testing is an element of each aspect, here it refers particularly to specific interactions and disturbances. Compliance and trend monitoring would be long-term projects, while hypothesis testing (similar to the studies done on Cuverville Island) would have specific time schedules.

SCAR and COMNAP, at the request of the Treaty Parties, produced reports (1992, 1996) in which monitoring was discussed in terms of all activities in the Antarctic, and emphasised hypothesis testing as the principle behind monitoring programmes. However, as with other literature on monitoring, the anthropogenic influences which are being referred to, or discussed, are those of greater magnitude than visitor disturbance. For example, pollution (*e.g.* waste generation) or direct modification of the environment (*e.g.* through construction), all of which are activities occurring at stations. While concentrating solely on hypothesis testing is suitable for monitoring impacts at a single site, and over a continuous period where identification of impacts is relatively straightforward, it is less relevant for tourist disturbances for the two reasons identified by Minbashian (1997).

While hypothesis testing is not to be excluded from a tourist landing site monitoring programme, in the absence of further information, both compliance and trend monitoring must be included. This ensures that the environmental integrity of individual sites, and of the region as a whole, is being monitored, and that the perceived need for information to *predict or to serve as a baseline for detecting environmental impacts of Antarctic tourism* (ATCM XIX , 1995: quoted in Section 2.5.3) could be satisfied.

Therefore, the three aspects of monitoring identified by Spellerberg (1994) could usefully be applied as follows:

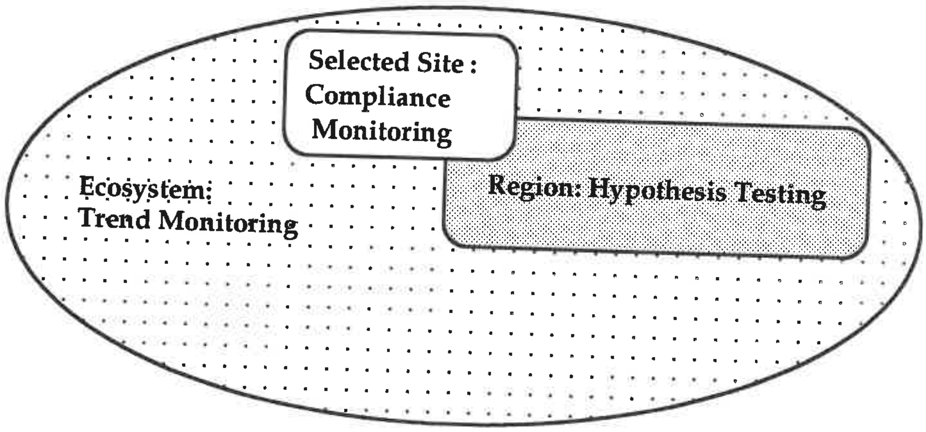
- *Compliance monitoring*: is appropriate for checking whether operations at landing sites, including measures for mitigating impacts, conform with the details provided with IEEs. It is currently the kind of monitoring required by the US-EPA to verify the IAATO programmatic impact assessment for tourist landing sites (Section 2.4.3).
- *Trend monitoring*: is appropriate for use at the scale of the Maritime Antarctic, the individual sub-regions (see Section 5.3) and at individual landing sites. This would provide a base against which to assess any changes in abundance and

distribution of wildlife populations, and levels of tourist activity on each scale.

- *Hypothesis testing*: is appropriate where knowledge of sites allows a hypothesis that relate causes and effects to be created and tested, as for example, was done at Cuverville Island.

The conceptual relationship between the different forms of activity and their geographic scale is illustrated in Figure 8.1. Although the different forms of monitoring vary in temporal and geographic scale, they complement each other to give a comprehensive view of the state of the environment and the consequences of human activities within it.

Figure 8.1Conceptual relationship between spatial scale and different categories of monitoring.



8.2.3 Defining objectives for monitoring

In Antarctica, perhaps more so than in other locations, a monitoring programme is likely to be restricted both by funding and logistics. This reinforces the need for clear objectives to ensure that suitable and efficient methods are designed (Munn, 1973; Goldsmith, 1991; Spellerberg, 1994; SCAR and COMNAP, 1992; Williams, 1996).

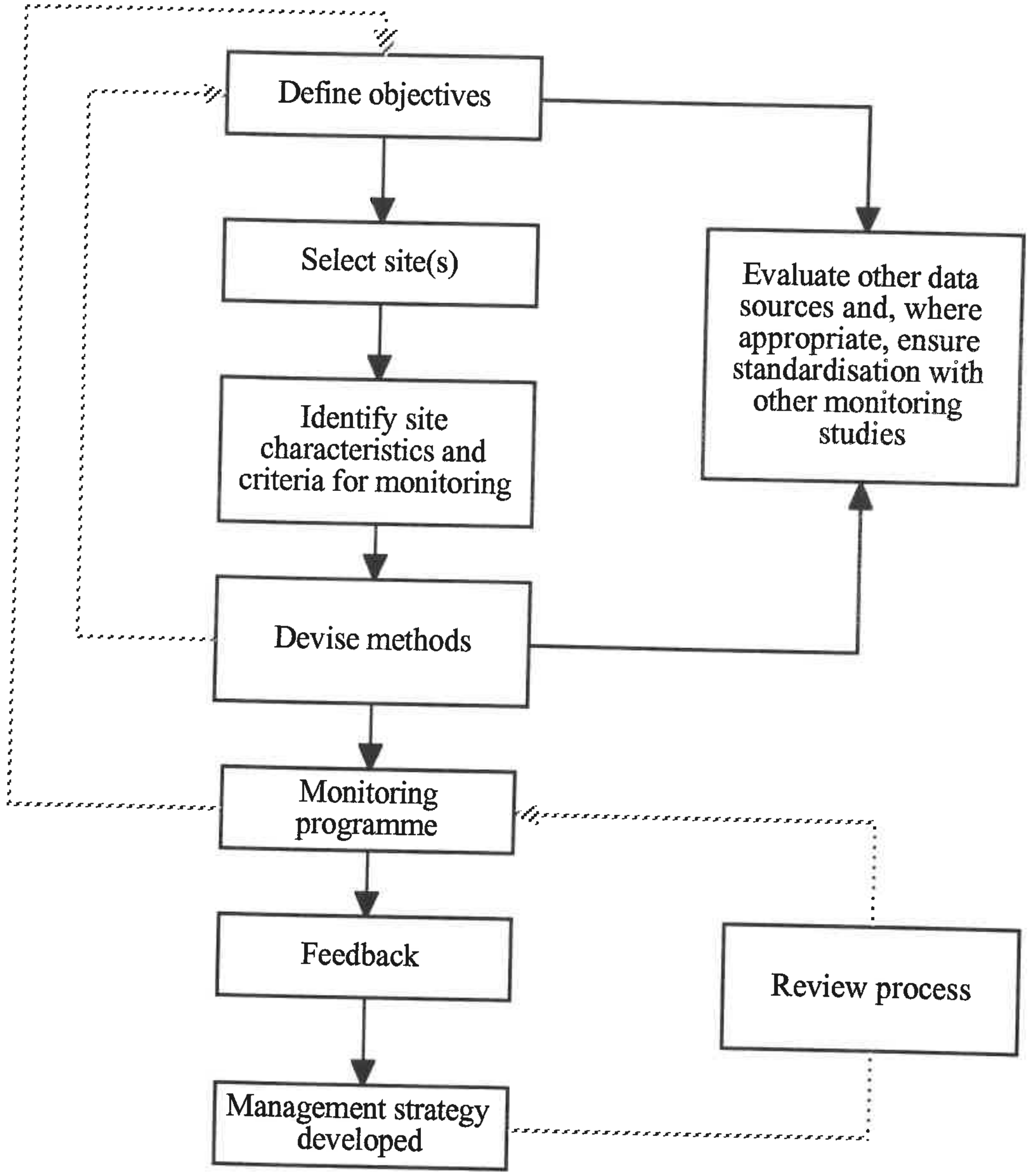
Monitoring and management are inextricably linked (Section 8.2.1). As defined in Section 1.4.2.1, the aim of managing tourist landing sites is to maintain the ecological integrity of those sites. At present, formal management practices advocated by tour operators are uniform for all sites, although sites may vary widely in terms of vulnerability (Sections 6.5 and 6.6). Thus, the primary objective for a tourist landing site monitoring programme should be to assess whether the present management practices are sufficient for maintaining the ecological integrity of individual sites, and, if not, to recommend improved management strategies. As the monitoring programme develops, specific objectives can be defined for individual sites and variables.

This clarifies *why* tourist landing sites should be monitored, but it leaves two further points to be specified, *what* and *how* to monitor, i.e. deciding the specific type of data required, and how these data are to be achieved. It also involves incorporating a series of iterative review stages to assess the appropriateness of objectives, variables and methods and, ultimately, whether or not the objectives have been met (Stankey *et al.*, 1990; Roberts, 1991; Spellerberg, 1994).

8.3 Developing techniques for monitoring tourist landing sites

A general design for a monitoring programme was provided by Spellerberg (1994), from which a model programme has been adapted for Antarctic landing sites (Fig. 8.2). The components of this model are discussed below. In examining them in relation to tourist landing sites in the Maritime Antarctic, the author does not attempt to prescribe a work-plan for monitoring the sites, but to outline the principles on which an effective monitoring programme would be based.

Figure 8.2 Conceptual plan for a monitoring programme. Solid lines indicate decision making steps to be taken, dotted lines show where revision of methods can take place. (Adapted from Spellerberg 1994)



Based on this plan, a landing site monitoring programme must be devised within practical, financial and temporal constraints. The programme must incorporate a series of review stages in order to assess whether the objectives are appropriate or are being met. Therefore, in developing a monitoring programme for landing sites, the following factors should be considered:

- *Current data sources*. These need to be examined both in relation to tourist activities and the state of the environment, to ensure that all data sources could be compatible and complementary;

- *Site selection*. As it would be impractical for all landing sites to be subject to detailed monitoring, individual sites, which are perceived either to be at risk or representative of the region, must be selected;
- *Criteria for monitoring*. It would be equally impractical to monitor all aspects of the Antarctic continuously, therefore variables should be identified which are appropriate for monitoring (on the basis of present knowledge); and finally
- *Methods for monitoring should* be devised at both the scientific and logistical level.

8.3.1 Current data sources

Collaboration is fundamental for a landing site monitoring programme (see also Section 8.4), as is ensuring compatibility with other studies. This is not only because co-operation and collaboration between governmental and non-governmental organisations is integral to the successful management of Antarctic tourism, but also because in these environments there are still many lacunae in the understanding, and knowledge, of the ecosystem. Any new information and data derived from monitoring need to be set in context with other data and, where possible, contribute to the understanding of this unique environment.

There are a variety of data sources and monitoring programmes which would complement a landing site monitoring programme. These can be divided into those relating to tourism activities, and those relating to the state of the environment.

8.3.1.1 Current Antarctic tourism data sources

There are six organisations collecting information relating to Antarctic tourist activities:

- NSF/IAATO collate data from the Post Visit Report Forms (see Section 5.2 and Appendix 4);

- In.Fue.Tur collect data on expeditions going to Antarctica from Ushuaia (see Section 3.3.1).
- Oceanites Antarctic Site Inventory Project (see Section 6.5.2) which is continuing data collection, when possible, in the Maritime Antarctic (Naveen, *pers. com.*);
- The United States Antarctic Programme is continuing their research at Torgersen Island near Palmer Station (Fraser and Patterson, 1997);
- The United Kingdom Antarctic Heritage Trust station at Port Lockroy measures visitor activity in relation to gentoo penguin breeding success (Cobley, *pers. com.*); and
- the Instituto Antárctico Argentino has been conducting research at Halfmoon Island to assess tourist activities and possible impacts on a chinstrap penguin colony (Aguirre and Acero, 1994), although, as yet, only preliminary results have been made available.

In addition to these six studies and data collection sources a further one is being established at Arctowski base, on King George Island in the South Shetland Islands, measuring the consequences of disturbance on elephant seals (Stonehouse and Rakusa-Suzczewski *pers. com.*). Any new monitoring programme would benefit from collaboration with these existing programmes, and careful consideration would be required to ensure a balance between avoiding overlaps in data collection and failing to acquire the correct information.

In addition to these current Antarctic tourism data sources there are also several data sources available on the state of the Antarctic environment which need to be taken into consideration.

8.3.1.2 Current data on the state of the Antarctic environment

There are numerous ecological studies, undertaken by various national Antarctic programmes which although not specific to tourism, offer valuable information on the state of the environment. Potentially, the most useful are the data accrued and collated by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Ecosystem Monitoring Programme (CEMP), which provides information on the state of the Antarctic marine ecosystem. CEMP was established initially as an *ad hoc working* group in 1984, with the mandate *to detect and record significant changes in critical components of the ecosystem, to serve as a basis for the Conservation of Antarctic Marine Living Resources*(Agnew, 1996: A2-51). It is concerned mainly with the implications of krill and fish harvesting, but has also published standard methods for monitoring seabird and seal populations (CCAMLR, 1992; Heap 1994: 170), with particular attention to penguin species. Standardising methods with those of CEMP makes it possible to compare data between programmes.

CEMP, however is not only useful for standardising methods but also from the information gained from the reviews of species. Since 1988 the Scientific Committee on Antarctic Research (SCAR) has produced three reviews of the status and trends of Antarctic and Sub-Antarctic seabirds which draw attention to several points of relevance to bird monitoring programmes. For example: the status and trends of most species of petrels, skuas, gulls and terns cannot be determined due to insufficient data (SCAR-BBS, 1996:2 (9); populations of most penguins, especially macaronis and rockhoppers, are currently decreasing compared with a decade ago (SCAR-BBS, 1996: 2(10)); more studies of giant petrel populations are needed (SCAR-BBS, 1996: 2(12)); and there is little, if any, evidence of change in penguin populations due to human activities near breeding colonies, although only a few sites are well documented (SCAR-BBS, 1996:2 (14)). Unfortunately, similar information has not yet been summarised for seal species (Boyd, *pers.com.*).

A monitoring programme should not only be aware of these data sources, but wherever possible, standardise data collection to enable comparison and a better understanding of the state of the environment as a whole. A landing site monitoring programme which is standardised with CCAMLR methods and results has two benefits: those of comparison and contribution.

8.3.2 Site selection

It would be impracticable to monitor all sites: it may well be unnecessary to monitor those comparatively invulnerable. Clearly, sites that have little or no wildlife close to the landing point (for example, Crystal Hill), and sites that have already been compromised ecologically (for example, any scientific station or Whalers Bay), are less vulnerable to loss of ecological integrity than biologically-rich sites (for example, Hannah Point, Penguin Island, Brown Bluff) that have several species of nesting birds (perhaps including such sensitive species as Dominican gulls and giant petrels) within easy reach of the landing point. Thus sites appropriate for monitoring need to be identified.

For sites to be categorised, two parameters need to be considered, (a) popularity and (b) ecological sensitivity. The first is measured by number of visits and visitors per annum, which can be derived from NSF/IAATO data. The second is more difficult to assess objectively.

Table 8.1 shows a simple way of categorising site popularity, measured by the number of visits recorded per season. 'Number of visits' is used as a criterion, because each visit represents a disturbance event. The possible alternative 'number of visitors' represents the amount of disturbance contained in the events, and could be argued to be more valid for vegetation and geology. But disturbance varies according to patterns of behaviour within the landing groups and so is less predictable. Kuss *et al.* (1990:163) suggest, based on literature studies of visitor disturbance to wildlife, *the number of people using an area has a smaller role in human-wildlife relationships than characteristics such as frequency of use... type... and behaviour*. By this criterion, therefore, 10 sites receive 'very high' or 'high' rates of visitation, in practice an average of one or two visits in each three-day period throughout the season, while 23 sites receive moderate to low levels of visitation, an average of one visit per week, while the remainder received only very occasional visits.

Table 8.1 Visitor use of sites in the South Shetland Islands, Northwest and Northeast sub-regions
The number of visits per season is taken from the data for the 1996/97 season. (Source NSF/IAATO, 1997)

Categorisation	Number of visits per season	Number of sites
Very high	Over 50	3
High	30 to 50	7
Moderate	15 to 30	3
Low	4 to 15	20
Minimal	1 to 3	34

Setting numerical values on ecological sensitivity is more difficult, controversial, and in the end, probably time-wasting. An alternative approach is simply to tabulate criteria for evaluation and to allow ecologists to make subjective assessments. This technique has successful precedents: Table 8.2 shows points for evaluation adopted by the Great Barrier Reef Marine Park Authority (WBM Oceanics Australia and Craig, 1997) which, although based almost entirely on seabird breeding populations, has considerable relevance for Antarctic tourist landing sites.

Data (for example, location and size of bird colonies, number of species present) will be required to make these preliminary evaluations for site selection: the two surveys (Stonehouse, 1995; Naveen, 1997b) described in Section 6.6 are a possible source, in addition to information available from earlier surveys (e.g. Müller-Schwarze andMüller-Schwarze, 1975; Poncet and Poncet, 1987).

The Barrier Reef Authority criteria offer flexibility in judging the values of sites. A site may be valuable because it contains large numbers of a variety of seabird species, or because it contains an abundance of a particular species, such as extensive patches of a certain moss species. Equally, sites could be valued if species are at the geographical limit of their range, as for example the macaroni penguins at Hannah Point, or where they represent the only colony or stand in the region. Table 8.2 also lists three social criteria on which sites can be valued: their value for education and awareness, their potential for scientific study and their value as a symbol for conservation issues.

Table 8.2 Criteria for evaluating sites. Adapted from WBM Oceanics Australia and Craig, 1997.

Criteria for evaluating landing sites
• the threat status of species involved (e.g. rare, vulnerable, low risk, unknown)
• overall size of the colonies and distribution (total number of breeding pairs, location in comparison to known landing points) including vegetation
• number of breeding species present
• whether or not a species is breeding at its geographic limit
• whether breeding aggregations of a species are common in the region
• the distance to other significant colonies of similar species
• value of physical features, and potential for modification through heavy use
• education / awareness opportunities at the site
• scientific opportunities at the site; and
• value of the aggregation of breeding species as a 'flagship' or 'icon' for conservation in the region / locality.

In practice, the number of sites that can be monitored is more likely to be determined by cost, and other practical considerations, rather than by indices of vulnerability established by formula. As discussed in Section 5.3, it is possible to categorise landing sites on the basis of their geographic location, divisions that concur with variation in environmental characteristics. This geographical categorisation aids the creation of suitable management and monitoring plans for each of the five sub-regions listed in Section 5.3 and their complement of landing sites. However, with a view to logistical and financial constraints, it may be sufficient, initially, to concentrate efforts on the South Shetland Islands, the Northwest Peninsula and the Northeast Peninsula. Neither the South Orkney Islands nor the Southwest Peninsula region are heavily visited, or have many known landing sites at present, while the South Shetland Islands, Northwest Peninsula and Northeast Peninsula receive the highest levels of visitation; the latter, although only recently accessible to shipborne tourism, is increasing in popularity (Section 5.4, Table 5.1).

Initially, the most practical resolution may be to select a number of sites, within these sub-regions, each with varying levels of popularity and value, and invite a panel of naturalists who are familiar with the area to evaluate them on the basis of their sensitivity and representative value, if possible placing them in order of priority.

Site selection needs to be done with care. Goldsmith (1991) examines the pitfalls of inadequate site selection, arguing that given the highly variable nature of living systems at every scale (over both time and space), a sample site may well not be representative of what is occurring at other sites elsewhere. Kuss *et al.*(1990) concur, stating that responses to disturbance are not only going to vary between species but between sites depending on factors such as habituation. Therefore, it is important in selecting sites to be aware of potential misrepresentation. This can be minimised by having sites which vary in amount of use and perceived vulnerability, thus ensuring that not only were sites perceived as under great risk (probably less than five sites) being monitored and managed, but also other key elements which apply in the sub-region.

In order to achieve this, three categories of sites within each region could be incorporated. These categories are as follows:

- *control sites*(high value, minimal amounts of use). Possible sites would include SSSIs or SPAs, such as Harmony Point (Nelson Island) and Cape Lion Rump (King George Island) in the South Shetland Islands, or Cierva Cove (Danco Coast) in the Northwest Peninsula. These sites usually have a good environmental description already, and, as permits are required to enter these sites, the numbers of visitors each season is known, and, usually, low. Information gathered at control sites would provide an indication of population trends within each of the five specified regions, similar to the Torgersen — Litchfield Island scenario (Fraser and Patterson, 1997). This information would be augmented by that from CEMP, which gives an indication of continental population trends.

- *Visitor reference sites*(high value, high level of use) can be identified for detailed monitoring of visitor use, including hypothesis related studies of human environmental interaction. Ideally these sites would be relatively heavily used each season with a reasonable diversity of populations, thus regarded as being of high educational and awareness value (see Table 8.2). They may also include some of the perceived ecologically sensitive populations, possibly in vulnerable locations, for example the southern giant petrels and macaroni penguins near the landing site at Hannah Point and the giant petrels and Antarctic terns at Penguin Island.

- *Comparison sites*(varying value, varying level of use) would provide the basis against which results from detailed monitoring at visitor reference sites and control sites could be normalised and any anomalies identified. This could be achieved through three means: by standardised general parameters being collected by each tour vessel once for each site visited during a season; and through the data gathered on each visit for the US-EPA (Table 1.4) and Post Visit Report Forms (Appendix 4); and through periodical surveying by trained monitoring personnel. As there are no restrictions on tour ships landing at previously unvisited sites, the standardised collection of these general parameters would also ensure that an environmental assessment had been conducted by the expedition leader prior to landing passengers.

Allocating a range of these sites within each of the sub-regions would provide a possible setting for the different forms of monitoring advocated by Spellerberg in Section 8.2.1 (compliance monitoring, trend monitoring and hypothesis testing). Compliance monitoring can be satisfied at comparison sites and visitor reference sites, monitoring how activities are conducted at there, hypothesis testing can be conducted at both the control sites and the visitor reference sites, and trend monitoring can occur by comparing the information from all three categories of site with each other and with data from other studies, such as CEMP.

8.3.3 Variables for monitoring

In selecting variables for monitoring, Spellerberg (1994) advocates the importance of maintaining simplicity, reliability and stability. This is not only for the initial selection of the variables, but also for subsequent data selection, collection and analysis. For all forms of monitoring environmental integrity, however, variables fall into two categories: non-biological and biological.

Non-biological factors include weather parameters (temperature, precipitation, snow cover), and ground factors (hydrology, soil erosion, geology and topography). There are strong arguments for including non-biological parameters in monitoring programmes (e.g. Furness and Greenwood,1993), especially in polar environments where physical factors so strongly influence the biological environment. A recent example of their value was the long-term monitoring of Adélie penguins near Palmer Station, where it emerged that a critical factor in determining successful breeding has been the annual distribution of sea ice (Fraser and Patterson, 1997).

Biological factors, for example distributions of plants, or numbers and breeding success of particular animal species, are traditionally used as indicators, with considerable success. Because of variations due to natural causes within and between populations, they need to be monitored for long periods (Emslie, 1997). Where hypotheses suggest particular causes for changes, it is essential also to monitor control populations where those causes do not apply. However, both methods of monitoring biological factors, and the inferred problems, are now well established.

SCAR COMNAP (1996: 14) advocate that... *a generic hypothesis should be used to generate specific hypotheses that are appropriate for particular locations, for the activities occurring at these locations and the values that may be impacted.* The generic hypothesis proposed by SCAR/COMNAP is that... *the activity of concern causes no unacceptable deterioration of values or resources.* In relation to visitor disturbance in Antarctica, Minbashian (1997) uses this hypothesis to assess different biological attributes commonly found at landing sites.

Her assessment concludes that bird and plant communities are the best parameters for measuring visitor disturbance. Seals were dismissed as their presence was highly variable, and they have only been monitored at a few sites (Cruwys and

Davis, 1994). Effects of visitor disturbance on resting and moulting elephant seals are currently being studied at Arctowski station (Stonehouse, *pers. com.*). In the future, these studies may provide a useful base for management decisions for seal species.

Microbes and invertebrates were discounted because of the lack of readily available information against which to standardise results from monitoring studies, and because sampling these communities would take considerable time and specialised field staff (Minbashian, 1997).Minbashian concludes that fresh water and littoral zones are of less concern: tourists rarely visit areas with freshwater lakes and these are usually well defined and easy to avoid (Author *pers.obs.*). Streams that are visited are close to the sea, where their ecosystems are less vulnerable to human disturbance. Tourist disturbance to the littoral zone is minor compared to disruption caused by iceberg and sea-ice scours.

Thus, due to ease of sampling and availability of information against which to normalise the data, bird and vegetation communities appear to be the most suitable subjects for landing site monitoring programmes.

8.3.4 Data collection: initial and subsequent procedures

Having selected sites for each of the three categories of sites, and having identified the variables to be monitored, baseline information and subsequent monitoring procedures need to be developed. For all categories of sites, initial procedures to establish baseline information can be devised through review of literature and field studies; subsequent procedures will vary depending on the categorisation of each of the sites .

8.3.4.1 Initial procedures

As the control and visitor reference sites are those where hypothesis testing will occur, they require more specific and accurate monitoring procedures. The comparison sites are for compliance and trend monitoring with the aim, over time, of normalising the results of the hypothesis testing sites and ensuring that management techniques are appropriate. Thus they require less detailed monitoring procedures, which favour practicality over accuracy. Monitoring of the control and visitor reference sites therefore should be done by trained assessors, while the comparison sites can revolve around simple standardised data collection techniques, such as those produced in the Seabird Monitoring Handbook (Walsh *et al.,* 1995), and which can be completed by members of the industry or by experienced volunteers.

At control sites, initial descriptions can be gained from SSSI and ASPA management plans. Further basic studies for these sites would depend on how recently, and to what extent, the selected site had been surveyed, and for what purposes the site was being used. However, the site and data collection must be comparable with that of the visitor reference site(s). Thus, even if the control site has been recently and comprehensively surveyed to a standard appropriate for inclusion in a landing site monitoring programme, a short visit, two days or less, should be undertaken to ensure that the site is suitable as a control site and that data are comparable. Visits to SSSIs or ASPAs would, of course, require a permit. Subsequent procedures would again be dependent on the purposes to which the control site was being used. In essence , annual surveys should correspond with those of the visitor reference sites.

For visitor reference sites, information may be available through reviewing literature and historical records. However, further basic studies would be required to ensure that: the site was topographically surveyed to a scale of 1:1000 to 1:2000; all key parameters had been identified and quantified, to a standard appropriate for inclusion in CEMP surveys; and patterns of visitor use identified, noting all known landing points. These surveys, which would take a few days at each site, should be done during December, thus ensuring that counts can be co-ordinated with specific species breeding chronologies wherever possible. A further re-assessment should be completed in January to confirm breeding species and success, and to assess vegetation abundance and distribution following snow melt. Ideally, subsequent counts of breeding species would occur as close to the same data each year as possible. At these sites, penguin censuses should follow CEMP standard methods. Censuses of flying bird species should follow standard methods used elsewhere for the same or similar species, such as those proposed in the Seabird Monitoring Handbook for Britain and Ireland (Walsh *et al*, 1995), and would cover skuas, shags, gulls, terns and cliff-nesting and burrowing species. In addition to the data collected on species distribution and abundance, further data collection may be required for specific sites where specific hypotheses are being tested.

For comparison sites, literature and historical reviews, particularly as the information from Oceanites and PAC become available, will be of more importance at these sites. Field studies of comparison sites would be opportunistic and tour ship-based, similar to the Oceanites and PAC studies. For logistical, practical and sound management reasons collaboration with the tour operators is the key for this phase of monitoring. It would be too expensive, and limiting, to deploy observers on each vessel, thus a simple standard assessment form, coupled with photodocumentation would be sufficient for such assessments. In order to ensure standardisation and to avoid unnecessary paper work, specific assessment forms could be drawn up for those sites which had already been mapped and species accounts already established. Tour operators would then only need to gather minimal information for these sites. More detailed assessment forms would be supplied for use at sites that had little or no previous documentation, or were to be visited for the first time.

8.3.4.2 Subsequent procedures

CEMP recommends that bird population and breeding success parameters should be measured for a minimum of ten years for trends to be established (CEMP, 1992). The Seabird Monitoring Handbook recommends frequent assessments of populations but gives no definitive end date (Walsh *et al.*,1995). However, it would be difficult to justify a landing site monitoring programme which did not have a definitive end point at the outset of the programme. Periodic review procedures should be set to assess whether monitoring objectives have been met. For the purposes of this study these review processes would be most appropriate at one, five and 10 year intervals.

After the first year, effectively a pilot study, the feasibility and appropriateness of the data collection would be reviewed and assessed. After five years, a further review process would again assess appropriateness, particularly in the light of any new findings. Finally, after 10 years a full assessment of the findings of the programme in view of the initial monitoring objectives would be conducted. If monitoring objectives have been met, and hypothesis confirmed or nullified satisfactorily this would be the end of this monitoring programme. If further hypothesis or monitoring objectives were developed, a new monitoring programme would need to be proposed.

8.4 Accepting responsibility

What degree of management is practicable under the Antarctic Treaty regime? Treaty Recommendations and the Protocol propound intentions to regulate all human activities in order to reduce casual despoilation of ecosystems. These intentions apply as much to landing sites as to sites around scientific stations, with the objectives summarised as the concept of *maintaining ecological integrity* (Section 1.4.2.1). Similarly there is an intention expressed that monitoring procedures be adopted. How can these intentions become practical for landing sites?

Elsewhere in the world, where 'maintaining ecological integrity' is defined as its management objective, a responsible authority commonly designates an agency to do this. Tasks of the agency might include (a) identifying what constitutes ecological integrity in specific areas, (b) establishing a monitoring programme to understand the consequences of disturbance to an ecosystem, (c) defining the practical long-term and short-term objectives specific to the areas considered, (d) drafting plans with practical measures for the specific objectives, and (e) devising procedures to determine whether the measures were effective. (Spellerberg, 1994)

Thus before any monitoring programme can be developed there are three questions to be answered. Who, in effect, will establish and co-ordinate the monitoring, and thence management, programme? Who will be responsible for the actual monitoring? Finally, how will the funding be raised? In the unusual political context of the Antarctic, these are difficult questions to answer.

The landing sites of the Maritime Antarctic are areas of wilderness or near-wilderness (in an ecological rather than legal sense: Sections 2.2.3 and 4) that are being used for the recreation of tourists. This is not unique: forest, desert, alpine and polar wilderness areas throughout the world are used for similar purposes (Johnston and Hall, 1995). For the Antarctic, uniqueness lies in the lack of a sovereign power to exercise management framework specific to the tourist sites, for example, to schedule them as recreational reserves (perhaps within a framework of national parks or monuments), to create bylaws for their protection, and provide rangers and naturalists to enforce them; determine objectives, devise short-term and long-term management plans, and to monitor them in order to confirm the effectiveness of management measures. In that there is no agency to take responsibility for the management of tourist landing sites. This is not the case for governmental expeditions many of whom have a designated environmental officer, a member of the recently established Antarctic Environmental Officers Network, whose duties include ensuring stations and field camps are managed in accordance with the Protocol.

For the good intentions of the Treaty System to be realised, some structure is needed to emulate the role of such an agency for tourist landing sites which would at least, create notional management objectives and proposals for effective monitoring. It is possible that the ATS's Committee for Environmental Protection (CEP) would be able to adopt such a role. The CEP is designed to provide *advice and formulate recommendations ... in connection with the implementation of this Protocol including the operation of its Annexes*(Appendix 3 Article12, quoted in Section 2.5.3). Although the role described in Annex 12 is largely advisory, the Annex does state...*as well as to* *perform such other functions as may be referred to it by the Antarctic Treaty Consultative Meetings.* If the CEP was to bear the responsibility of monitoring tourism impacts it would likely be in a form similar to that adopted by CCAMLR, i.e. by establishing a working group, which would include a data manager, responsible for collation, and analysis of monitoring data from which the working group would provide management recommendations. Within their remit they would operate and co-ordinate with experienced ecologists responsible for the actual trend and hypothesis testing monitoring of the sites.

Success would depend upon co-operation and collaboration with the tour industry, in particular IAATO. As suggested in Section 8.3.4.1, tour operators could be included in the data collection, using a set of standardised site assessment forms, which, where ever possible, would be specific to individual sites. As expedition leaders are ultimately responsible for the enactment of any management strategies, IAATO could also organise a training programme for expedition leaders. This would not only ensure that data collection was understood and standardised, but would also provide a direct forum for diffusion of ideas and recommendations regarding site management and monitoring.

Finally both management and monitoring are costly procedures, especially for Antarctica where logistics are expensive, and riddled with difficulties (Agnew, 1996). Data collection toward management and monitoring within the industry have hitherto been undertaken mainly by expedition leaders and other tour guides in the course of other duties, and studies researching tourism management have been funded opportunistically by research grants from the NSF and other Treaty Party agencies and supported logistically by the industry. The monitoring considered in this chapter involves however, a commitment for long-term field-work and data-work, which would be an expensive undertaking.

There are several options, funding could continue to be raised on an opportunistic basis, as it has for the research studies to date: e.g. through charitable foundation (research) grants, etc. Alternatively, the most obvious fund-raising would be for tour operators to approach their clients. This could be done in several ways, from auctions aboard vessels, to adding an 'optional' extra cost to the cruise. Charging landing fees or levying taxes on tourists is unlikely to be acceptable to most parties involved, not only because this sets a precedent for commercialism above and beyond the industry, but it contravenes the spirit of freedom of access, inherent in the Antarctic Treaty. It would be more appropriate, and possibly more acceptable, to promote an 'optional' extra cost, in the form of a donation prior to, or during, a voyage, by which passengers could knowingly contribute to a scheme monitoring tourist landing sites on a continuing basis. Similar programmes have operated for some years with success (e.g. Earthwatch), whereby participants pay to assist researchers in various parts of the world, primarily on environmental topics. A mechanism could be devised by which clients of yacht operators in Antarctica could become part of the contributors or volunteers.

Realistically, to raise enough money to support a monitoring programme a combination of research grants and monies collected from tourists would be more practical. Monies collected could be administered by a sub-committee of the CEP, which could also appoint a Treaty related organisation (e.g. SCAR) to be involved in the recruiting and screening of qualified senior investigators responsible for the monitoring programmes

8.5 Discussions and conclusions

Tourism in the Antarctic has not yet resulted in any great environmental impact largely because it has been prudently managed by the industry within the guidelines established by the Protocol. The vulnerable points in the environment are the landing sites but, because tourists are given guidance in preliminary briefings for visits which seldom last more than 2 – 3 hours and are carefully controlled by experienced staff, there is little evidence of harmful ecological effects. However, for each expedition every individual visit to a site occurs in isolation, but the cumulative effects of repeated visits at frequent intervals over the season by numerous expeditions, may have a more significant impact.

To date, there is little evidence on which to base an evaluation. Yet this is a critical point for two reasons. First, it is a basic purpose of the Treaty Parties to maintain the Antarctic environment in its natural state for scientific research and, implicitly, this entails ensuring that human interference is reduced to a minimum through careful management. Nevertheless, without established baselines this is not possible.

Second, tourists are made aware that there has been a degree of devastation, sometimes around some current or abandoned scientific stations. Yet these represent the prime reason for the Treaty Parties aim. In turn, tourists to the Antarctic, partly because of their nationality, partly because they are articulate informed individuals, are a major force in creating and reinforcing the global perception of a continent which generates extraordinary widespread interest.

The need to provide hard data on current or potential impacts is a major reason for establishing a monitoring programme which would provide the basis for management strategies, is accepted by most parties. By harnessing the good will of the industry and the tourists, a practical, effective monitoring programme based on the guidelines discussed in this chapter could be conceived.

Chapter 9
Summary of conclusions

Against the perspective and scale of the vast continent of Antarctica with the geophysical activities associated with plate tectonics, the prolonged periodsof time involved with the movements of glaciers and ice sheets, and the fluctutions in the natural biological cycle, tourism, of which the majority is restricted to a very small section of the periphery, may seem to be of very minor significance. Nevertheless, as Ward and Dubos wrote 25 years ago, man inhabits two worlds. It is the Antarctic environment *as perceived* that influences and shapes the attitudes and policies towards the continent and its utilisation.

This thesis reviews aspects of Antarctic tourism, in particular the environmental impacts of commercial shipborne tourism in the Maritime Antarctic, and ways in which the Antarctic Treaty System seeks to control both the industry and its effects. It concentrates in particular on issues surrounding the protection of the tourist landing sites, which are defined as the main points of impact between the tourist industry and the environment.

Antarctic tourism forms part of a world-wide movement toward nature tourism. Although the tourist operators have a consistent record of sound environmental practices, as yet there is insufficient evidence to support the claim that the industry does no significant environmental damage and is sustainable. Tourism's reputation for damaging environments elsewhere in the world contributes to suspicions that, in Antarctica, it cannot fail to be harmful both to ecosystems and to scientific research that the Antarctic Treaty System is committed to protecting.

The concept of wilderness is generally applicable to the Antarctic in the geographical and ecological sense, and is referred to as such under the Protocol on

Environmental Protection to the Antarctic Treaty. However, wilderness has not yet been properly defined which creates difficulties for consistent and effective management amongst the relevant powers. As most operators and clients of Antarctic shipborne tourism are US citizens or organisations, the industry comes largely under the control of a US government agency, the Environmental Protection Agency (US-EPA), which is currently coming to grips with its newly-acquired responsibilities and powers.

Of the four forms of Antarctic tourism reviewed, commercial shipborne tourism is found to be by far the most extensive: its recent growth is charted, and further growth during the next decade considered inevitable. The environmentally-benign 'Lindblad pattern' of adventure tourism, involving strong educational elements aboard and frequent small-boat landings ashore, continues to dominate the industry's activities, but is believed by some to be becoming less effective as the industry expands. Furthermore, as the majority of shipborne tourist activity is being concentrated in the ecologically richest area of the Antarctic, it would appear to have an increasing capacity to damage the environment.

Despite intense competition for clients, the shipborne industry has a history of co-operation over environmentally-effective codes of conduct for the industry and guidelines for clients, which the Treaty System had endorsed. Environmental responsibilities imposed by the Protocol on Environmental Protection to the Antarctic Treaty require a more formal approach, an Initial Environmental Evaluation (IEE), which has been prepared on behalf of the industry by the International Association of Antarctica Tours Operators (IAATO), its trade organisation.

IAATO proposed a programmatic IEE which was accepted by the US-EPA, covering all US-operator activities in the Maritime Antarctic in one document. In preparing the programmatic IEE, IAATO developed a series of matrices to describe the industry's activities in ships, in small boats and ashore, and to identify in general terms the hazards created and methods of mitigation. These matrices, although effective for ship and small boat operations, were not successful for shore operations, unable to acknowledge individual differences between the sites. It was therefore possible to conclude that a generalised IEE that does not take these differences into account will not accurately describe either the impacts arising from individual landings at different sites or the cumulative impacts arising from repeated visits. Thus the Interim Final Rule of the US-EPA, which enacts the Protocol in US legislation, and under which assessments of impacts are verified, appear inadequate, and inconsistent with principles of the Protocol.

Nevertheless, landings continue to provide the main opportunities for the industry to inflict environmental damage. Analysis of data reporting tourist visits to 128 landing sites in the Maritime Antarctic during the past eight seasons reveals patterns of change in five variables: numbers of passenger, ships, voyages, sites used and landings made. Sites are grouped into five geographical sub-regions of which two — those most accessible and reliably ice-free — are most frequently visited.

Activities continue to concentrate at relatively few sites within these two sub-regions. Numbers of voyages have increased rapidly in recent years due to the emergence of shorter, cheaper cruises, involving small Russian research ships; this has lead to a disproportionate increase in numbers of landings made each season (in comparison to the number of tourists). A recent decrease in numbers of shipborne tourists (due to the non-participation of two ships) is not reflected either in frequency of landings at individual sites or in numbers of sites visited.

Although policies of both IAATO and individual operators are reflected in cruise itineraries, choice of sites used and the ways in which passengers are managed ashore are left to the discretion of individual expedition leaders, who vary widely in experience and ecological understanding. Thus individual sites are subject to different management practices which may, or may not, be complimentary, and may, or may not be appropriate. Inevitably each expedition leader is concerned primarily with their own visit(s) to a site, considering not how many times the site has been visited but whether another vessel is scheduled there at the same time. Thus the number and frequency of landings at individual sites is not necessarily taken into consideration for 'vulnerable' sites, and the level of use at individual sites is incidentally determined by expedition leaders.

The three-season study at Cuverville Island, a popular landing site, indicated several useful points for management and monitoring of all tourist landing sites. The author was responsible for mapping the site, making ecological inventories of vegetation, birds and mammals, and estimating breeding success in experimental and control areas. Although ecological disturbance by visitors was generally slight and short-term, different species responded in different ways to the presence of both visitors and researchers.

Groups of tourists used the site in various ways, the size of the group affecting the degree of dispersion, yet on the whole visitors used a much smaller area than the total available. The author found no evidence to suggest that visitors interfered with predator/prey relations between skuas and gentoo penguins. The Cuverville Island project provided a model for the kind of ecological survey that will be required as a prerequisite at all landing sites where management and monitoring are needed.

Drawing on both her Cuverville Island experiences and repeated visits to over 85 landing sites in the Maritime Antarctic, the author concludes that, if the Treaty System is to fulfil its self-imposed obligations, thus maintaining the ecological integrity of the landing sites and promoting responsible monitoring, there is a need for a more definite approach to both managing and monitoring the sites. The peculiarities of Antarctic ecosystems are no bar to good management practices. Environmental management principles elaborated in other parts of the world can readily be adapted to Maritime Antarctic conditions.

The author reviews definitions of ecological monitoring, and of compliance, trend and hypothesis-testing monitoring in the context of the landing sites, and provides recommendations a model programme combining management and monitoring, adapted to the needs of the landing sites. She concludes that the kind of monitoring required to ensure the ecological integrity of the sites requires first, sound primary and secondary management objectives, and second, several stages of monitoring toward the development of a management strategy, embodied in a management plan, which is then monitored until it is perceived as successfully maintaining the ecological integrity of the sites under consideration or for as long as shipborne tourism continues. Although the principles are the same for all sites, each site will require its own management plan.

The final conclusions are that, there is not only a requirement under the Protocol to establish a comprehensive monitoring and management strategy, but there is a genuine need to test whether the present use of Antarctic tourist landing sites is and will continue to be sustainable. In order to achieve this, and to ensure that monitoring and management strategies are both practical and effective, the co-operation and collaboration of the industry is required. It would be unusual to have the industry whose effects are being monitored so closely associated with the programme, however, this is a unique situation. The industry has already shown a commitment to environmentally benign practices, and, as in the absence of sovereignty, peer pressure will almost certainly continue to play a role, the benefits of working with the industry would be substantial.

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Galimberti, Ms. D.	Observer for Instituo Fueguino de Turismo - Oficina Antártica	Cuverville Island, Antarctica, February, 1994
Gemmell, Dr. I	Medical Officer for British Antarctic Survey, Rothera Station 1993 - 1995.	Cambridge, June, 1995
Heap, Dr J.	Director, Scott Polar Research Institute	SPRI, Cambridge, August, 1996
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Landau, Ms. D.	Environmental Officer, Quark Expeditions and Executive Committee Member, IAATO	Airlie, Virginia, USA, September, 1996
Naveen, Mr R.	President, Oceanities	Washington D.C., July 1997
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Poncet, Mrs S.	Independent biologist, author and yachtowner.	Falkand Islands, February 1996
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Shaw, Mr. P	Vice President, Marine Expeditions	Airlie, Virginia, USA, September, 1996
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Appendix 1:
Antarctic Treaty text and signatories

A. Text of the Antarctic Treaty

The Governments of Argentina, Australia, Belgium, Chile, the French Republic, Japan, New Zealand, Norway, the Union of South Africa, the Union of Soviet Socialist Republics, the United Kingdom of Great Britain and Northern Ireland, and the United States of America,

Recognizing that it is in the interest of all mankind that Antarctica shall continue for ever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord;

Acknowledging the substantial contributions to scientific knowledge resulting from international cooperation in scientific investigation in Antarctica;

Convinced that the establishment of a firm foundation for the continuation and development of such cooperation on the basis of freedom of scientific investigation in Antarctica as applied during the International Geophysical Year accords with the interests of science and the progress of all mankind;

Convinced also that a treaty ensuring the use of Antarctica for peaceful purposes only and the continuance of international harmony in Antarctica will further the purposes and principles embodied in the Charter of the United Nations;

Have agreed as follows:

Article I

1. Antarctica shall be used for peaceful purposes only. There shall be prohibited, *inter alia*, any measure of a military nature, such as the establishment of military bases and fortifications, the carrying out of military manoeuvres, as well as the testing of any type of weapon.
2. The present Treaty shall not prevent the use of military personnel or equipment for scientific research or for any other peaceful purpose.

Article II

Freedom of scientific investigation in Antarctica and cooperation toward that end, as applied during the International Geophysical Year, shall continue, subject to the provisions of the present Treaty.

Article III

1. In order to promote international cooperation in scientific investigation in Antarctica, as provided for in Article II of the present Treaty, the Contracting Parties agree that, to the greatest extent feasible and practicable:
   a. information regarding plans for scientific programs in Antarctica shall be exchanged to permit maximum economy of and efficiency of operations;
   b. scientific personnel shall be exchanged in Antarctica between expeditions and stations;
   c. scientific observations and results from Antarctica shall be exchanged and made freely available.
2. In implementing this Article, every encouragement shall be given to the establishment of cooperative working relations with those Specilized Agencies of the United Nations and other technical organizations having a scientific or technical interest in Antarctica.

Article IV

1. Nothing contained in the present Treaty shall be interpreted as:
   a. a renunciation by any Contracting Party of previously asserted rights of or claims to territorial sovereignty in Antarctica;
   b. a renunciation or diminution by any Contracting Party of any basis of claim to territorial sovereignty in Antarctica which it may have whether as a result of its activities or those of its nationals in Antarctica, or otherwise;

c. prejudicing the position of any Contracting Party as regards its recognition or non-recognition of any other State's rights of or claim or basis of claim to territorial sovereignty in Antarctica.

2. No acts or activities taking place while the present Treaty is in force shall constitute a basis for asserting, supporting or denying a claim to territorial sovereignty in Antarctica or create any rights of sovereignty in Antarctica. No new claim, or enlargement of an existing claim, to territorial sovereignty in Antarctica shall be asserted while the present Treaty is in force.

Article V

1. Any nuclear explosions in Antarctica and the disposal there of radioactive waste material shall be prohibited.
2. In the event of the conclusion of international agreements concerning the use of nuclear energy, including nuclear explosions and the disposal of radioactive waste material, to which all of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX are parties, the rules established under such agreements shall apply in Antarctica.

Article VI

The provisions of the present Treaty shall apply to the area south of 60° South Latitude, including all ice shelves, but nothing in the present Treaty shall prejudice or in any way affect the rights, or the exercise of the rights, of any State under international law with regard to the high seas within that area.

Article VII

1. In order to promote the objectives and ensure the observance of the provisions of the present Treaty, each Contracting Party whose representatives are entitled to participate in the meetings referred to in Article IX of the Treaty shall have the right to designate observers to carry out any inspection provided for by the present Article. Observers shall be nationals of the Contracting Parties which designate them. The names of observers shall be communicated to every other Contracting Party having the right to designate observers, and like notice shall be given of the termination of their appointment.
2. Each observer designated in accordance with the provisions of paragraph 1 of this Article shall have complete freedom of access at any time to any or all areas of Antarctica.
3. All areas of Antarctica, including all stations, installations and equipment within those areas, and all ships and aircraft at points of discharging or embarking cargoes or personnel in Antarctica, shall be open at all times to inspection by any observers designated in accordance with paragraph 1 of this Article.
4. Aerial observation may be carried out at any time over any or all areas of Antarctica by any of the Contracting Parties having the right to designate observers.
5. Each Contracting Party shall, at the time when the present Treaty enters into force for it, inform the other Contracting Parties, and thereafter shall give them notice in advance, of
   a. all expeditions to and within Antarctica, on the part of its ships or nationals, and all expeditions to Antarctica organized in or proceeding from its territory;
   b. all stations in Antarctica occupied by its nationals; and
   c. any military personnel or equipment intended to be introduced by it into Antarctica subject to the conditions prescribed in paragraph 2 of Article I of the present Treaty.

Article VIII

1. In order to facilitate the exercise of their functions under the present Treaty, and without prejudice to the respective positions of the Contracting Parties relating to jurisdiction over all other persons in Antarctica, observers designated under paragraph 1 of Article VII and scientific personnel exchanged under sub-paragraph 1(b) of Article III of the Treaty, and members of the staffs accompanying any such persons, shall be subject only to the jurisdiction of the Contracting Party of which they are nationals in respect of all acts or omissions occurring while they are in Antarctica for the purpose of exercising their functions.
2. Without prejudice to the provisions of paragraph 1 of this Article, and pending the adoption of measures in pursuance of subparagraph 1(e) of Article IX, the Contracting Parties concerned in any case of dispute with regard to the exercise of jurisdiction in Antarctica shall immediately consult together with a view to reaching a mutually acceptable solution.

Article IX

1. Representatives of the Contracting Parties named in the preamble to the present Treaty shall meet at the City of Canberra within two months after the date of entry into force of the Treaty, and thereafter at suitable intervals and places, for the purpose of exchanging information, consulting together on matters of common interest pertaining to Antarctica, and formulating and considering, and recommending to their Governments, measures in furtherance of the principles and objectives of the Treaty, including measures regarding:
   a. use of Antarctica for peaceful purposes only;
   b. facilitation of scientific research in Antarctica;
   c. facilitation of international scientific cooperation in Antarctica;
   d. facilitation of the exercise of the rights of inspection provided for in Article VII of the Treaty;
   e. questions relating to the exercise of jurisdiction in Antarctica;
   f. preservation and conservation of living resources in Antarctica.
2. Each Contracting Party which has become a party to the present Treaty by accession under Article XIII shall be entitled to appoint representatives to participate in the meetings referred to in paragraph 1 of the present Article, during such times as that Contracting Party demonstrates its interest in Antarctica by conducting substantial research activity there, such as the establishment of a scientific station or the despatch of a scientific expedition.
3. Reports from the observers referred to in Article VII of the present Treaty shall be transmitted to the representatives of the Contracting Parties participating in the meetings referred to in paragraph 1 of the present Article.
4. The measures referred to in paragraph 1 of this Article shall become effective when approved by all the Contracting Parties whose representatives were entitled to participate in the meetings held to consider those measures.
5. Any or all of the rights established in the present Treaty may be exercised as from the date of entry into force of the Treaty whether or not any measures facilitating the exercise of such rights have been proposed, considered or approved as provided in this Article.

Article X

Each of the Contracting Parties undertakes to exert appropriate efforts, consistent with the Charter of the United Nations, to the end that no one engages in any activity in Antarctica contrary to the principles or purposes of the present Treaty.

Article XI

1. If any dispute arises between two or more of the Contracting Parties concerning the interpretation or application of the present Treaty, those Contracting Parties shall consult among themselves with a view to having the dispute resolved by negotiation, inquiry, mediation, conciliation, arbitration, judicial settlement or other peaceful means of their own choice.
2. Any dispute of this character not so resolved shall, with the consent, in each case, of all parties to the dispute, be referred to the International Court of Justice for settlement; but failure to reach agreement on reference to the International Court shall not absolve parties to the dispute from the responsibility of continuing to seek to resolve it by any of the various peaceful means referred to in paragraph 1 of this Article.

Article XII

1. a. The present Treaty may be modified or amended at any time by unanimous agreement of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX. Any such modification or amendment shall enter into force when the depositary Government has received notice from all such Contracting Parties that they have ratified it.
   b. Such modification or amendment shall thereafter enter into force as to any other Contracting Party when notice of ratification by it has been received by the depositary Government. Any such Contracting Party from which no notice of ratification is received within a period of two years from the date of entry into force of the modification or amendment in accordance with the provision of subparagraph 1(a) of this Article shall be deemed to have withdrawn from the present Treaty on the date of the expiration of such period.
2. a. If after the expiration of thirty years from the date of entry into force of the present Treaty, any of the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX so requests by a communication addressed to the depositary

Government, a Conference of all the Contracting Parties shall be held as soon as practicable to review the operation of the Treaty.

b. Any modification or amendment to the present Treaty which is approved at such a Conference by a majority of the Contracting Parties there represented, including a majority of those whose representatives are entitled to participate in the meetings provided for under Article IX, shall be communicated by the depositary Government to all Contracting Parties immediately after the termination of the Conference and shall enter into force in accordance with the provisions of paragraph 1 of the present Article

c. If any such modification or amendment has not entered into force in accordance with the provisions of subparagraph 1(a) of this Article within a period of two years after the date of its communication to all the Contracting Parties, any Contracting Party may at any time after the expiration of that period give notice to the depositary Government of its withdrawal from the present Treaty; and such withdrawal shall take effect two years after the receipt of the notice by the depositary Government.

Article XIII

1. The present Treaty shall be subject to ratification by the signatory States. It shall be open for accession by any State which is a Member of the United Nations, or by any other State which may be invited to accede to the Treaty with the consent of all the Contracting Parties whose representatives are entitled to participate in the meetings provided for under Article IX of the Treaty.
2. Ratification of or accession to the present Treaty shall be effected by each State in accordance with its constitutional processes.
3. Instruments of ratification and instruments of accession shall be deposited with the Government of the United States of America, hereby designated as the depositary Government.
4. The depositary Government shall inform all signatory and acceding States of the date of each deposit of an instrument of ratification or accession, and the date of entry into force of the Treaty and of any modification or amendment thereto.
5. Upon the deposit of instruments of ratification by all the signatory States, the present Treaty shall enter into force for those States and for States which have deposited instruments of accession. Thereafter the Treaty shall enter into force for any acceding State upon the deposit of its instruments of accession.
6. The present Treaty shall be registered by the depositary Government pursuant to Article 102 of the Charter of the United Nations.

Article XIV

The present Treaty, done in the English, French, Russian and Spanish languages, each version being equally authentic, shall be deposited in the archives of the Government of the United States of America, which shall transmit duly certified copies thereof to the Governments of the signatory and acceding States.

B. Signatories to the Antarctic Treaty

The Antarctic Treaty was signed in Washington on 1 December 1959 by 12 states, and entered into force for those states on 23 June 1961. Below are listed in chronological order the dates of ratification of the Treaty by the original signatories, the dates of accession or succession by other states, and the dates upon which acceding states became Consultative Parties.

OS = Original Signatory CP = Consultative party AS = Acceding State

	State	*Date*	*Status*	*Date when Acceding State became Consultative Party*
1	United Kingdom	31 May 1960	OS/CP	
2	South Africa	21 June 1960	OS/CP	
3	Belgium	26 July 1960	OS/CP	
4	Japan	4 Aug 1960	OS/CP	
5	United States of America	18 Aug 1960	OS/CP	

6	Norway	24	Aug 1960	OS/CP		
7	France	16	Sept 1960	OS/CP		
8	New Zealand	1	Nov 1960	OS/CP		
9	Russia [1]	2	Nov 1960	OS/CP		
10	Poland	8	June 1961	AS/CP	29	July 1977
11	Argentina	23	June 1961	OS/CP		
12	Australia	23	June 1961	OS/CP		
13	Chile	23	June 1961	OS/CP		
14	Czech Republic [2]	14	June 1962	AS		
15	Slovak Republic [2]	14	June 1952	AS		
16	Denmark	20	May 1965	AS		
17	Netherlands	30	Mar 1967	AS/CP	19	Nov 1990
18	Romania	15	Sept 1971	AS		
	German Democratic Republic [3]	19	Nov 1974	AS/CP	5	Oct 1987
19	Brazil	16	May 1975	AS/CP	12	Sept 1983
20	Bulgaria	11	Sept 1978	AS		
21	Germany, Federal Republic of	5	Feb 1979	AS/CP	3	Mar 1981
22	Uruguay	11	Jan 1980	AS/CP	7	Oct 1985
23	Papua New Guinea [4]	16	Mar 1981	AS		
24	Italy	18	Mar 1981	AS/CP	5	Oct 1987
25	Peru	10	April 1981	AS/CP	9	Oct 1989
26	Spain	31	Mar 1982	AS/CP	21	Sept 1988
27	China, People's Republic of	8	June 1983	AS/CP	7	Oct 1985
28	India	19	Aug 1983	AS/CP	12	Sept 1983
29	Hungary	27	Jan 1984	AS		
30	Sweden	24	April 1984	AS/CP	21	Sept 1988
31	Finland	15	May 1984	AS/CP	9	Oct 1989
32	Cuba	16	Aug 1984	AS		
33	Korea, Republic of	28	Nov 1986	AS/CP	9	Oct 1989
34	Greece	8	Jan 1987	AS		
35	Korea, Democratic People's Republic of	21	Jan 1987	AS		
36	Austria	25	Aug 1987	AS		
37	Ecuador	15	Sept 1987	AS/CP	19	Nov 1990
38	Canada	4	May 1988	AS		
39	Colombia	31	Jan 1989	AS		
40	Switzerland	15	Nov 1990	AS		
41	Guatemala	31	July 1991	AS		
42	Ukraine	28	Oct 1992	AS		
43	Turkey	25	Jan 1996	AS		

Notes

1. Known as the Soviet Union until December 1990.
2. Succeeded to the Treaty as part of Czechoslovakia which separated into two republics on 1 January 1993.
3. Became united with Federal Republic of Germany on 3 October 1990.
4. Succeeded to the Treaty after independence from Australia.

Appendix 2:

ATCM Recommendation XVIII-1: Tourism and non-Governmental Activities

The Representatives,

Reaffirming the exceptional character of the Antarctic environment given in particular the fragility of its fauna and flora and of the setting which the Antarctic offers for the conduct of scientific activities;

Acknowledging the increase in the development of tourist activities in the Antarctic;

Noting that those who visit the Antarctic and organise or conduct tourism and non-governmental activities in the Antarctic are currently subject to legally binding obligations pursuant to national legislation implementing the Antarctic Treaty and associated legal instruments;

Noting further that such visitors or organisers will be subject to additional legally binding obligations upon entry into force of the Protocol on Environmental Protection to the Antarctic Treaty;

Recognizing the need for visitors and organisers to have practical guidance on how best to plan and carry out any visits to the Antarctic;

Recalling the Final Act of the Eleventh Special Antarctic Treaty Consultative Meeting, at which the Protocol was adopted, in which the signatories of the Final Act decided that the Annexes of the Protocol should be applied in accordance with their legal systems and to the extent practicable;

Desiring to ensure that those who visit the Antarctic carry out their visits or tours strictly in accordance with existing obligations and in so far as is consistent with existing national law, in accordance with the Protocol, pending its entry into force;

Desiring further to facilitate the early entry into force of the Protocol and of the implementation of its provisions in relation to those who visit or organise tours to the Antarctic.

Recommend to their Governments that:

1. They circulate widely and as quickly as possible the Guidance for Visitors to the Antarctic and the Guidance for Those Organising and Conducting Tourism and Non-governmental Activities in the Antarctic annexed to this Recommendation.

2. They urge those intending to visit or organise and conduct tourism and non-governmental activities in the Antarctic to act in accordance with the attached guidance consistent with the relevant provisions of their applicable national law.

Attachment

Guidance for Visitors to the Antarctic

Activities in the Antarctic are governed by the Antarctic Treaty of 1959 and associated agreements, referred to collectively as the Antarctic Treaty system. The Treaty established Antarctica as a zone of peace and science.

In 1991, the Antarctic Treaty Consultative Parties adopted the Protocol on Environmental Protection to the Antarctic Treaty, which designates the Antarctic as a natural reserve. The Protocol sets out environmental principles, procedures and obligations for the comprehensive protection of the Antarctic environment, and its dependent and associated ecosystems. The Consultative Parties have agreed that, pending its entry into force, as far as possible and in accordance with their legal system, the provisions of the Protocol should be applied as appropriate.

The Environmental Protocol applies to tourism and non-governmental activities as well as governmental activities in the Antarctic Treaty Area. It is intended to ensure that these activities do not have adverse impacts on the Antarctic environment, or on its scientific and aesthetic values.

This Guidance for Visitors to the Antarctic is intended to ensure that all visitors are aware of, and are therefore able to comply with, the Treaty and the Protocol. Visitors are, of course, bound by national laws and regulations applicable to activities in the Antarctic.

A) Protect Antarctic Wildlife

Taking or harmful interference with Antarctic wildlife is prohibited except in accordance with a permit issued by a national authority.

1) Do not use aircraft, vessels, small boats, or other means of transport in ways that disturb wildlife, either at sea or on land.

2) Do not feed, touch, or handle birds or seals, or approach or photograph them in ways that cause them to alter their behaviour. Special care is needed when animals are breeding or moulting.

3) Do not damage plants, for example by walking, driving, or landing on extensive moss beds or lichen-covered scree slopes.

4) Do not use guns or explosives. Keep noise to the minimum to avoid frightening wildlife.

5) Do not bring non-native plants or animals into the Antarctic (e.g. live poultry, pet dogs and cats, house plants).

B) Respect Protected Areas

A variety of areas in the Antarctic have been afforded special protection because of their particular ecological, scientific, historic or other values. Entry into certain areas may be prohibited except in accordance with a permit issued by an appropriate national authority. Activities in and near designated Historic Sites and Monuments and certain other areas may be subject to special restrictions.

1) Know the locations of areas that have been afforded special protection and any restrictions regarding entry and activities that can be carried out in and near them.

2) Observe applicable restrictions.

3) Do not damage, remove or destroy Historic Sites or Monuments, or any artifacts associated with them.

C) Respect Scientific Research

Do not interfere with scientific research, facilities or equipment.

1) Obtain permission before visiting Antarctic science and logistic support facilities; reconfirm arrangements 24-72 hours before arriving; and comply strictly with the rules regarding such visits.

2) Do not interfere with, or remove, scientific equipment or marker posts, and do not disturb experimental study sites, field camps, or supplies.

D) Be Safe

Be prepared for severe and changeable weather. Ensure that your equipment and clothing meet Antarctic standards. Remember that the Antarctic environment is inhospitable, unpredictable and potentially dangerous.

1) Know your capabilities, the dangers posed by the Antarctic environment, and act accordingly. Plan activities with safety in mind at all times.

2) Keep a safe distance from all wildlife, both on land and at sea.

3) Take note of, and act on, the advice and instructions from your leaders; do not stray from your group.

4) Do not walk onto glaciers or large snow fields without proper equipment and experience; there is a real danger of falling into hidden crevasses.

5) Do not expect a rescue service; self-sufficiency is increased and risks reduced by sound planning, quality equipment, and trained personnel.

6) Do not enter emergency refuges (except in emergencies). If you use equipment or food from a refuge, inform the nearest research station or national authority once the emergency is over.

7) Respect any smoking restrictions, particularly around buildings, and take great care to safeguard against the danger of fire. This is a real hazard in the dry environment of Antarctica.

E) Keep Antarctica Pristine

Antarctica remains relatively pristine, and has not yet been subjected to large scale human perturbations. It is the largest wilderness area on earth. Please keep it that way.

1) Do not dispose of litter or garbage on land. Open burning is prohibited.

2) Do not disturb or pollute lakes or streams. Any materials discarded at sea must be disposed of properly.

3) Do not paint or engrave names or graffiti on rocks or buildings.

4) Do not collect or take away biological or geological specimens or man-made artifacts as a souvenir, including rocks, bones, eggs, fossils, and parts or contents of buildings.

5) Do not deface or vandalize buildings, whether occupied, abandoned, or unoccupied, or emergency refuges.

Guidance for Those Organising and Conducting Tourism and Non-governmental Activities in the Antarctic

Antarctica is the largest wilderness area on earth, unaffected by large scale human activities. Accordingly, this unique and pristine environment has been afforded special protection. Furthermore, it is physically remote, inhospitable, unpredictable and potentially dangerous. All activities in the Antarctic Treaty Area, therefore, should be planned and conducted with both environmental protection and safety in mind.

Activities in the Antarctic are subject to the Antarctic Treaty of 1959 and associated legal instruments, referred to collectively as the Antarctic Treaty system. These include the Convention for the Conservation of Antarctic Seals (CCAS) (1972), the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) (1980) and the Recommendations and other measures adopted by the Antarctic Treaty Consultative Parties under the Antarctic Treaty.

In 1991, the Consultative Parties to the Antarctic Treaty adopted the Protocol on Environmental Protection to the Antarctic Treaty. This Protocol sets out environmental principles, procedures and obligations for the comprehensive protection of the Antarctic environment, and its dependent and associated ecosystems. The Consultative Parties have agreed that, pending its entry into force, as far as possible and in accordance with their legal systems, that the provisions of the Protocol should be applied as appropriate.

The Environmental Protocol designates Antarctica as a natural reserve devoted to peace and science, and applies to both governmental and non-governmental activities in the Antarctic Treaty Area. The Protocol seeks to ensure that human activities, including tourism, do not have adverse impacts on the Antarctic environment, nor on its scientific and aesthetic values.

The Protocol states, as a matter of principle, that all activities are to be planned and conducted on the basis of information sufficient to evaluate their possible impact on the Antarctic environment and its associated ecosystems, and on the value of Antarctica for the conduct of scientific research. Organisers should be aware that the Environmental Protocol requires that "activities shall be modified, suspended or cancelled if they result in or threaten to result in impacts upon the Antarctic environment or dependent or associated ecosystems."

Those responsible for organising and conducting tourism and non-governmental activities must comply fully with national laws and regulations which implement the Antarctic Treaty system, as well as other national laws and regulations implementing international agreements on environmental protection, pollution and safety that related to the Antarctic Treaty Area. They should also abide by the requirements imposed on organisers and operators under the Protocol on Environmental Protection and its Annexes, in so far as they have not yet been implemented in national law.

Key Obligations On Organisers And Operators

1) Provide prior notification of, and reports on, their activities to the competent authorities of the appropriate Party or Parties.

2) Conduct an assessment of the potential environmental impacts of their planned activities.

3) Provide for effective response to environmental emergencies, especially with regard to marine pollution.

4) Ensure self-sufficiency and safe operations.

5) Respect scientific research and the Antarctic environment, including restrictions regarding protected areas, and the protection of flora and fauna.

6) Prevent the disposal and discharge of prohibited waste.

Procedures To Be Followed By Organisers And Operators

A) When Planning To Go To The Antarctic

Organisers and operators should:

1) Notify the competent national authorities of the appropriate Party or Parties of details of their planned activities with sufficient time to enable the Party(ies) to comply with their information exchange obligations under Article VII(5) of the Antarctic Treaty. The information to be provided is listed in Attachment A.

2) Conduct an environmental assessment in accordance with such procedures as may have been established in national law to give effect to Annex I of the Protocol, including, if appropriate, how potential impacts will be monitored.

3) Obtain timely permission from the national authorities responsible for any stations they propose to visit.

4) Provide information to assist in the preparation of: contingency response plans in accordance with Article 15 of the Protocol; waste management plans in accordance with Annex III of the Protocol; and marine pollution contingency plans in accordance with Annex IV of the Protocol.

5) Ensure that expedition leaders and passengers are aware of the location and special regimes which apply to Specially Protected Areas and Sites of Special Scientific Interest (and on entry into force of the Protocol, Antarctic Specially Protected Areas and Antarctic Specially Managed Areas) and of Historic Sites and Monument and, in particular, relevant management plans.

6) Obtain a permit, where required by national law, from the competent national authority of the appropriate Party or Parties, should they have a reason to enter such areas, or a monitoring site (CEMP Site) designated under CCAMLR.

7) Ensure that activities are fully self-sufficient and do not require assistance from Parties unless arrangements for it have been agreed in advance.

8) Ensure that they employ experienced and trained personnel, including a sufficient number of guides.

9) Arrange to use equipment, vehicles, vessels, and aircraft appropriate to Antarctic operations.

10) Be fully conversant with applicable communications, navigation, air traffic control and emergency procedures.

11) Obtain the best available maps and hydrographic charts, recognising that many areas are not fully or accurately surveyed.

12) Consider the question of insurance (subject to requirements of national law).

13) Design and conduct information and education programmes to ensure that all personnel and visitors are aware of relevant provisions of the Antarctic Treaty system.

14) Provide visitors with a copy of the Guidance for Visitors to the Antarctic.

B) When In The Antarctic Treaty Area Organisers and operators should:

1) Comply with all requirements of the Antarctic Treaty system, and relevant national laws, and ensure that visitors are aware of requirements that are relevant to them.

2) Reconfirm arrangements to visit stations 24-72 hours before their arrival and ensure that visitors are aware of any conditions or restrictions established by the station.

3) Ensure that visitors are supervised by a sufficient number of guides who have adequate experience and training in Antarctic conditions and knowledge of the Antarctic Treaty system requirements.

4) Monitor environmental impacts of their activities, if appropriate, and advise the competent national authorities of the appropriate Party or Parties of any adverse or cumulative impacts resulting from an activity, but which were not foreseen by their environmental impact assessment.

5) Operate ships, yachts, small boats, aircraft, hovercraft, and all other means of transport safely and according to appropriate procedures, including those set out in the Antarctic Flight Information Manual (AFIM).

6) Dispose of waste materials in accordance with Annex V of the Protocol. These annexes prohibit, among other things, the discharge of plastics, oil and noxious substances into the Antarctic Treaty Area; regulate the discharge of sewage and food waste; and require the removal of most waste from the area.

7) Co-operate fully with observers designated by Consultative Parties to conduct inspections of stations, ships, aircraft and equipment under Article VII of the Antarctic Treaty, and those to be designated under Article 14 of the Environmental Protocol.

8) Cooperate in monitoring programs undertaken in accordance with Article 3(2) (d) of the Protocol.

9) Maintain a careful and complete record of their activities conducted.

C) On Completion Of The Activities

Within three months of the end of the activity, organisers and operators should report on the conduct of it to the appropriate national authority in accordance with national laws and procedures. Reports should include the name, details and state of registration of each vessel or aircraft used and the name of their captain or commander; actual itinerary; the number of visitors engaged in the activity; places, dates and purposes of landings and the number of visitors landed on each occasion; any meteorological observations made, including those made a part of the World Meteorological Organization (WMO) Voluntary Observing Ships Scheme; any significant changes in activities and their impacts from those predicted before the visit was conducted; and action taken in case of emergency.

D) Antarctic Treaty System Documents And Information

Most Antarctic Treaty Parties can provide through their national contact points copies of relevant provisions of the Antarctic Treaty system and information about national laws and procedures, including:

The Antarctic Treaty (1959)
Convention for the Conservation of Antarctic Seals (1972)
Convention on the Conservation of Antarctic Marine Living Resources (1980)
Protocol on Environmental Protection to the Antarctic Treaty (1991)
Recommendations and other measures adopted under the Antarctic Treaty
Final Reports of Consultative Meetings
Handbook of the Antarctic Treaty System (1994)
Handbook of the Antarctic Treaty System (in Spanish, 1991 edition)

Attachment A

Information To Be Provided in Advance Notice

Organisers should provide the following information to the appropriate national authorities in the format requested.

1. name, nationality, and contact details of the organiser;

2. where relevant, registered name and national registration and type of any vessel or aircraft to be used (including name of the captain or commander, call-sign, radio frequency, IMMARSAT number);

3. intended itinerary including the date of departure and places to be visited in the Antarctic Treaty Area;

4. activities to be undertaken and purpose;

5. number and qualifications of crew and accompanying guides and expedition staff;

6. estimated number of visitors to be carried;

7. carrying capacity of vessel;

8. intended use of vessel;

9. intended use and type of aircraft;

10. number and type of other vessels, including small boats, to be used in the Antarctic Treaty Area;

11. information about insurance coverage;

12. details of equipment to be used, including for safety purposes, and arrangements for self-sufficiency;

13. and other matters required by national laws.

Appendix 3

Excerpts from the Protocol on Environmental Protection to the Antarctic Treaty and Annex 1.

PREAMBLE

The States Parties to this Protocol to the Antarctic Treaty, hereinafter referred to as the Parties,

Convinced of the need to enhance the protection of the Antarctic environment and dependent and associated ecosystems;

Convinced of the need to strengthen the Antarctic Treaty system so as to ensure that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord;

Bearing in mind the special legal and political status of Antarctica and the special responsibility of the Antarctic Treaty Consultative Parties to ensure that all activities in Antarctica are consistent with the purposes and principles of the Antarctic Treaty;

Recalling the designation of Antarctica as a Special Conservation Area and other measures adopted under the Antarctic Treaty system to protect the Antarctic environment and dependent and associated ecosystems;

Acknowledging further the unique opportunities Antarctica offers for scientific monitoring of and research on processes of global as well as regional importance;

Reaffirming the conservation principles of the Convention on the Conservation of Antarctic Marine Living Resources;

Convinced that the development of a comprehensive regime for the protection of the Antarctic environment and dependent and associated ecosystems is in the interest of mankind as a whole;

Desiring to supplement the Antarctic Treaty to this end;

Have agreed as follows:

ARTICLE 1

Definitions

For the purposes of this Protocol:

(a) "The Antarctic Treaty" means the Antarctic Treaty done at Washington on 1 December 1959;

(b) "Antarctic Treaty area" means the area to which the provisions of the Antarctic Treaty apply in accordance with Article VI of that Treaty;

(c) "Antarctic Treaty Consultative Meetings" means the meetings referred to in Article IX of the Antarctic Treaty;

(d) "Antarctic Treaty Consultative Parties" means the Contracting Parties to the Antarctic Treaty entitled to appoint representatives to participate in the meetings referred to in Article IX of that Treaty;

(e) "Antarctic Treaty system" means the Antarctic Treaty, the measures in effect under that Treaty, its associated separate international instruments in force and the measures in effect under those instruments;

(f) "Arbitral Tribunal" means the Arbitral Tribunal established in accordance with the Schedule to this Protocol, which forms an integral part thereof;

(g) "Committee" means the Committee for Environmental Protection established in accordance with Article 11.

ARTICLE 2

Objective and Designation

The Parties commit themselves to the comprehensive protection of the Antarctic environment and dependent and associated ecosystems and hereby designate Antarctica as a natural reserve, devoted to peace and science.

ARTICLE 8

Environmental Impact Assessment

1. Proposed activities referred to in paragraph 2 below shall be subject to the procedures set out in Annex I for prior assessment of the impacts of those activities on the Antarctic environment or on dependent or associated ecosystems according to whether those activities are identified as having:
   (a) less than a minor or transitory impact;
   (b) a minor transitory impact; or
   (c) more than a minor or transitory impact.
2. Each Party shall ensure that the assessment procedures set out in Annex I are applied in the planning processes leading to decisions about any activities undertaken in the Antarctic Treaty area pursuant to scientific research programmes, tourism and all other governmental and non-governmental activities in the Antarctic Treaty area for which advance notice is required under Article VII (5) of the Antarctic Treaty, including associated logistic support activities.
3. The assessment procedures set out in Annex I shall apply to any change in an activity whether the change arises from an increase or decrease in the intensity of an existing activity, from the addition of an activity, the decommissioning of a facility, or otherwise.
4. Where activities are planned jointly by more than one Party, the Parties involved shall nominate one of their number to coordinate the implementation of the environmental impact assessment procedures set out in Annex I.

ARTICLE 11

Committee for Environmental Protection

1. There is hereby established the Committee for Environmental Protection.
2. Each Party shall be entitled to be a member of the Committee and to appoint a representative who may be accompanied by experts and advisers.
3. Observer status in the Committee shall be open to any Contracting Party to the Antarctic Treaty which is not a Party to this Protocol.
4. The Committee shall invite the President of the Scientific Committee on Antarctic Research and the Chairman of the Scientific Committee for the Conservation of Antarctic Marine Living Resources to participate as observers at its sessions. The Committee may also, with the approval of the Antarctic Treaty Consultative Meeting, invite such other relevant scientific, environmental and technical organisations which can contribute to its work to participate as observers at its sessions.
5. The Committee shall present a report on each of its sessions to the Antarctic Treaty Consultative Meeting. The report shall cover all matters considered at the session and shall reflect the views expressed. The report shall be circulated to the Parties and to observers attending the session, and shall thereupon be made publicly available.
6. The Committee shall adopt its rules of procedure which shall be subject to approval by the Antarctic Treaty Consultative Meeting.

ARTICLE 12

Functions of the Committee

1. The functions of the Committee shall be to provide advice and formulate recommendations to the Parties in connection with the implementation of this Protocol, including the operation of its Annexes, for consideration at Antarctic Treaty Consultative Meetings, and to perform such other functions as may be referred to it by the Antarctic Treaty Consultative Meetings. In particular, it shall provide advice on:
   (a) the effectiveness of measures taken pursuant to this Protocol;
   (b) the need to update, strengthen or otherwise improve such measures;
   (c) the need for additional measures, including the need for additional Annexes, where appropriate;
   (d) the application and implementation of the environmental impact assessment procedures set out in Article 8 and Annex I;
   (e) means of minimising or mitigating environmental impacts of activities in the Antarctic Treaty area;

(f) procedures for situations requiring urgent action, including response action in environmental emergencies;

(g) the operation and further elaboration of the Antarctic Protected Area system;

(h) inspection procedures, including formats for inspection reports and checklists for the conduct of inspections;

(i) the collection, archiving, exchange and evaluation of information related to environmental protection;

(j) the state of the Antarctic environment; and

(k) the need for scientific research, including environmental monitoring, related to the implementation of this Protocol.

2. In carrying out its functions, the Committee shall, as appropriate, consult with the Scientific Committee on Antarctic Research, the Scientific Committee for the Conservation of Antarctic Marine Living Resources and other relevant scientific, environmental and technical organizations.

ARTICLE 13

Compliance with this Protocol

1. Each Party shall take appropriate measures within its competence, including the adoption of laws and regulations, administrative actions and enforcement measures, to ensure compliance with this Protocol.
2. Each Party shall exert appropriate efforts, consistent with the Charter of the United Nations, to the end that no one engages in any activity contrary to this Protocol.
3. Each Party shall notify all other Parties of the measures it takes pursuant to paragraphs 1 and 2 above.
4. Each Party shall draw the attention of all other Parties to any activity which in its opinion affects the implementation of the objectives and principles of this Protocol.
5. The Antarctic Treaty Consultative Meetings shall draw the attention of any State which is not a Party to this Protocol to any activity undertaken by that State, its agencies, instrumentalities, natural or juridical persons, ships, aircraft or other means of transport which affects the implementation of the objectives and principles of this Protocol.

ANNEX I TO THE PROTOCOL ON ENVIRONMENTAL PROTECTION TO THE ANTARCTIC TREATY

ENVIRONMENTAL IMPACT ASSESSMENT

ARTICLE 1

Preliminary Stage

1. The environmental impacts of proposed activities referred to in Article 8 of the Protocol shall, before their commencement, be considered in accordance with appropriate national procedures.
2. If an activity is determined as having less than a minor or transitory impact, the activity may proceed forthwith.

ARTICLE 2

Initial Environmental Evaluation

1. Unless it has been determined that an activity will have less than a minor or transitory impact, or unless a Comprehensive Environmental Evaluation is being prepared in accordance with Article 3, an Initial Environmental Evaluation shall be prepared. It shall contain sufficient detail to assess whether a proposed activity may have more than a minor or transitory impact and shall include:

   (a) a description of the proposed activity, including its purpose, location, duration and intensity; and

   (b) consideration of alternatives to the proposed activity and any impacts that the activity may have, including consideration of cumulative impacts in the light of existing and known planned activities.

2. If an Initial Environmental Evaluation indicates that a proposed activity is likely to have no more than a minor or transitory impact, the activity may proceed, provided that appropriate procedures, which may include monitoring, are put in place to assess and verify the impact of the activity.

ARTICLE 3

Comprehensive Environmental Evaluation

1. If an Initial Environmental Evaluation indicates or if it is otherwise determined that a proposed activity is likely to have more than a minor or transitory impact, a Comprehensive Environmental Evaluation shall be prepared.
2. A Comprehensive Environmental Evaluation shall include:
   (a) a description of the proposed activity including its purpose, location, duration and intensity, and possible alternatives to the activity, including the alternative of not proceeding, and the consequences of those alternatives;
   (b) a description of the initial environmental reference state with which predicted changes are to be compared and a prediction of the future environmental reference state in the absence of the proposed activity;
   (c) a description of the methods and data used to forecast the impacts of the proposed activity;
   (d) estimation of the nature, extent, duration and intensity of the likely direct impacts of the proposed activity;
   (e) consideration of possible indirect or second order impacts of the proposed activity;
   (f) consideration of cumulative impacts of the proposed activity in the light of existing activities and other known planned activities;
   (g) identification of measures, including monitoring programmes, that could be taken to minimise or mitigate impacts of the proposed activity and to detect unforeseen impacts and that could provide early warning of any adverse effects of the activity as well as to deal promptly and effectively with accidents;
   (h) identification of unavoidable impacts of the proposed activity;
   (i) consideration of the effects of the proposed activity on the conduct of scientific research and on other existing uses and values;
   (j) an identification of gaps in knowledge and uncertainties encountered in compiling the information required under this paragraph;
   (k) a non-technical summary of the information provided under this paragraph; and
   (l) the name and address of the person or organization which prepared the Comprehensive Environmental Evaluation and the address to which comments thereon should be directed.
3. The draft Comprehensive Environmental Evaluation shall be made publicly available and shall be circulated to all Parties, which shall also make it publicly available, for comment. A period of 90 days shall be allowed for the receipt of comments.
4. The draft Comprehensive Environmental Evaluation shall be forwarded to the Committee at the same time as it is circulated to the Parties, and at least 120 days before the next Antarctic Treaty Consultative Meeting, for consideration as appropriate.
5. No final decision shall be taken to proceed with the proposed activity in the Antarctic Treaty area unless there has been an opportunity for consideration of the draft Comprehensive Environmental Evaluation by the Antarctic Treaty Consultative Meeting on the advice of the Committee, provided that no decision to proceed with a proposed activity shall be delayed through the operation of this paragraph for longer than 15 months from the date of circulation of the draft Comprehensive Environmental Evaluation.
6. A final Comprehensive Environmental Evaluation shall address and shall include or summarise comments received on the draft Comprehensive Environmental Evaluation. The final Comprehensive Environmental Evaluation, notice of any decisions relating thereto, and any evaluation of the significance of the predicted impacts in relation to the advantages of the proposed activity, shall be circulated to all Parties, which shall also make them publicly available, at least 60 days before the commencement of the proposed activity in the Antarctic Treaty area.

ARTICLE 4

Decisions to be Based on Comprehensive Environmental Evaluations

Any decision on whether a proposed activity, to which Article 3 applies, should proceed, and, if so, whether in its original or in a modified form, shall be based on the Comprehensive Environmental Evaluation as well as other relevant considerations.

ARTICLE 5

Monitoring

1. Procedures shall be put in place, including appropriate monitoring of key environmental indicators, to assess and verify the impact of any activity that proceeds following the completion of a Comprehensive Environmental Evaluation.
2. The procedures referred to in paragraph 1 above and in Article 2 (2) shall be designed to provide a regular and verifiable record of the impacts of the activity in order, *inter alia*, to:
   (a) enable assessments to be made of the extent to which such impacts are consistent with the Protocol; and
   (b) provide information useful for minimising or mitigating impacts, and, where appropriate, information on the need for suspension, cancellation or modification of the activity.

ARTICLE 6

Circulation of Information

1. The following information shall be circulated to the Parties, forwarded to the Committee and made publicly available:
   (a) a description of the procedures referred to in Article 1;
   (b) an annual list of any Initial Environmental Evaluations prepared in accordance with Article 2 and any decisions taken in consequence thereof;
   (c) significant information obtained, and any action taken in consequence thereof, from procedures put in place in accordance with Articles 2 (2) and 5; and
   (d) information referred to in Article 3 (6).
2. Any Initial Environmental Evaluation prepared in accordance with Article 2 shall be made available on request.

ARTICLE 7

Cases of Emergency

1. This Annex shall not apply in cases of emergency relating to the safety of human life or of ships, aircraft or equipment and facilities of high value, or the protection of the environment, which require an activity to be undertaken without completion of the procedures set out in this Annex.
2. Notice of activities undertaken in cases of emergency, which would otherwise have required preparation of a Comprehensive Environmental Evaluation, shall be circulated immediately to all Parties and to the Committee and a full explanation of the activities carried out shall be provided within 90 days of those activities.

ARTICLE 8

Amendment or Modification

1. This Annex may be amended or modified by a measure adopted in accordance with Article IX (1) of the Antarctic Treaty. Unless the measure specifies otherwise, the amendment or modification shall be deemed to have been approved, and shall become effective, one year after the close of the Antarctic Treaty Consultative Meeting at which it was adopted, unless one or more of the Antarctic Treaty Consultative Parties notifies the Depositary, within that period, that it wishes an extension of that period or that it is unable to approve the measure.
2. Any amendment or modification of this Annex which becomes effective in accordance with paragraph 1 above shall thereafter become effective as to any other Party when notice of approval by it has been received by the Depositary.

Appendix 4

POST-VISIT REPORT: PART 1 - Tour Record

1

Instructions

The Tour Record is completed for every tour or non-governmental expedition. This information is requested in compliance with Antarctic Treaty Recommendation XVIII-1 and Resolution XIX-3 (1995).

A: Expedition Details

Company name:	Cruise / Flight number:
Expedition Leader(s) name:	Vessel name / aircraft registration:
☐ Ship ☐ Yacht ☐ Aircraft (check)	Captain's / commander's name:
Port and date of embarkation:	Port and date of disembarkation:
Actual itinerary travelled — please provide description of route, giving dates. Note: if you consider the Site Visit Record (SVR) provides an adequate description of itinerary simply write "See SVR":	

B: Observers

Name:	Name:	Name:
Affiliation:	Affiliation:	Affiliation:

C: Record of Expedition numbers by nationality

Nationality	Number of Pax[1]	Staff[2]	Crew[3]	Nationality	Number of Pax[1]	Staff[2]	Crew[3]	Nationality	Number of Pax[1]	Staff[2]	Crew[3]
								TOTAL			

[1] **Pax (Passengers):** Members of the Expedition that are not Staff or Crew.
[2] **Staff:** Expedition personnel, guides, lecturers and small boat drivers.
[3] **Crew:** Vessel's captain and officers, aircraft pilots, crew and hotel / catering staff (excluding above).

D: Report on Expedition by Expedition Leader (please be brief, but use additional sheets if necessary)

1. Has a meteorological report been submitted to the World Meteorological Organization? ☐ Yes ☐ No ☐ Don't Know
2. List any unusual incidents affecting people or the environment.
3. If there were any unusual incidents, has or will an incident report be prepared? ☐ Yes ☐ No ☐ Don't Know
4. To whom has or will the incident report be provided?
5. Any other comments or observations (e.g. observations of distrubance to wildlife or the physical environment, changes from expedition Advance Notification, etc.):

Signature: ____________________ *Expedition Leader or Vessel Captain* Date: ____________

POST-VISIT REPORT: PART 2 — Site Visit Record

Instructions

One line of the Site Visit Record should be completed per site wherever Expedition members disembark or journey beyond base or camp.

Tour Company or Name: ____________________ **Vessel Name:** ________________ **Cruise / Flight Number:** ________

Date(s)	Site Visited	Site latitude / longitude	Duration of visit from time first passengers left vessel / aircraft / base / camp	Duration of passenger activities at site visited	Number of people making site visit			Activities at site (List all codes that apply)
					Pax[1]	Staff[2]	Crew[3]	

[1] **Pax** (Passengers): Members of the Expedition that are not Staff or Crew.
[2] **Staff:** Expedition personnel, guides, lecturers and small boat drivers.
[3] **Crew:** Vessel's captain and officers, aircraft pilots, crew and hotel / catering staff (excluding above).

Activity codes

Small boat landing:	**BL**	Aircraft landing:	**AL**	Helicopter landing:	**HL**	Station visit:	**SV**
Small boat cruising:	**ZC**	Aircraft flight:	**AF**	Helicopter flight:	**HF**	Camping:	**CP**

Appendix 5

Maritime Antarctic sites visited since 1989/90

The data presented in this table is compiled from the NSF / IAATO table of Antarctic Peninsula sites visited between the 1989/90 season and the 1996/97 season. The table excludes sites that do not fall within the boundaries of the martime Antarctic as defined in the Introduction. Where the same site has been listed under two different names, these sites have been combined under one name in brackets afterwards, for example: DAMOY POINT, WIENCKE IS. (aka Dorian Bay).

SO = South Orkney Islands
SS = South Shetland Islands
NW = Northwest Peninsula
SW = Southwest Peninsula
NE = Northeast Peninsula

SITE (coordinates to be completed...)	**REGION**	**NO. OF LANDINGS SINCE 1989/90**
ADMIRALTY SOUND (64°20`S, 57°10`W)	NE	3
AITCHO ISLANDS (island not named) (62°24`S, 59°47`W)	SS	85
ALCOCK ISLAND (64°14`S, 61°08`W)	NW	2
ALMIRANTE BROWN (STATION), (64°51`S 62°54`W)	NW	208
ARAGO GLACIER, ANDVORD BAY (64°51`S, 62°23`W)	NW	6
ARCTOWSKI (STATION) (62°10`S 58°29`W)	SS	142
ARDLEY ISLAND (62°13`S, 58°56`W)	SS	11
ARGENTINE IS. (not Vernadsky Station) (65°15`S, 64°16`W)	NW	1
ARTIGAS (STATION)	SS	3
ARTURO PRAT (STATION), GREENWHICH ISLAND	SS	7
ASTROLABE ISLAND (63°17`S, 58°40`W)	NW	12
BAILY HEAD, DECEPTION IS. (62°58`S, 60°30`W)	SS	109
BELLINGSHAUSEN (STATION), KGI	SS	35
BERNARDO O'HIGGINS BASE	SS	1
BLAIKLOCK ISLAND (67° 33`S, 67°04`W)	SW	1
BRADBROOKE ISLAND (not unamed Aitcho Is.) (62°24`S, 59°47`W)	SS	1
BROWN BLUFF (62° 32`S, 56°55`W)	NE	15
CAMARA (STATION), HALFMOON IS. (62° 36`S, 59°55`W)	SS	178
CAMP POINT west coast Graham Land (??)	NW	1
CAPE DUNDAS, LAURIE IS., (60° 44`S, 44°24`W)	SO	1

CAPE GAGE, JAMES ROSS ISLAND (64° 10`S, 57°05`W)	NE	2
CAPE LOOKOUT, ELEPHANT IS. (61° 16`S, 55°12`W)	SS	47
CAPE MELVILLE, KGI (62° 02`S, 57°37`W)	SS	1
CAPE TUXEN, MT. DEMARIA (65° 16`S, 64°08`W)	NW	2
CAPE VALENTINE, ELEPHANT IS. (61°06`S, 54°39`W)	SS	2
CHALLENGER ISLAND(64°21`S, 61°35`W)	NW	1
CHARLOTTE BAY (aka Portal Point)(64°33`S, 61°39`W)	NW	5
COMB RIDGE, JAMES ROSS ISLAND(63°55`S, 57°28`W)	NE	1
CORMORANT ISLAND(63°48`S, 63°58`W)	NW	1
CORONATION ISLAND, S. ORKNEYS(60°37`S, 45°35`W)	SO	35
CRYSTAL HILL(63°39`S, 57°44`W)	NE	6
CRYSTAL SOUND, PENDLETON STRAIT(66°23`S, 66°30`W)	SW	2
CURTISS BAY(64°02`S, 60°47`W)	NW	4
CUVERVILLE ISLAND(64°41`S, 62°38`W)	NW	251
DAMOY POINT, WIENCKE IS. (aka Dorian Bay)(64°49`S, 63°32`W)	NW	10
DANCO ISLAND(64°44`S, 62°37`W)	NW	28
DANGER ISLANDS (63°25`S, 54°40`W)	NE	7
DECEPTION ISLAND (62°57`S, 60°38`W)	SS	18
DETAILLE ISLAND (66°52`S, 66°48`W)	SW	9
DEVIL ISLAND (63°48`S, 57°17`W)	NE	13
DURVILLE MOUNT, JOINVILLE ISLAND (62°24`S, 59°47`W)	NE	1
DUTHIERS POINT (62°48`S, 62°49`W)	SS	2
FALSE BAY, LIVINGSTON IS. (62°43`S, 60°22`W)	SS	1
FERRAZ (STATION),	SS	41
FILDES PENINSULA (62°12`S, 58°58`W)	SS	1
FISH ISLANDS (66°02`S, 65°25`W)	SW	1
FOYN HARBOR also Enterprise Island (64°33`S, 62°01`W)	NW	4
FUMAROLE BAY, DECEPTION IS. (62°58`S, 60°42`W)	SS	1
GABRIEL DE DASTILLA STATION (62°24`S, 59°47`W)	SS	1
GASTON ISLANDS (64°28`S, 61°50`W)	NW	1
GENNADY COVE, INTERCURRENCE IS.	NE	1
GEORGE'S POINT, RONGE' ISLAND (64°40`S, 62°40`W)	NW	42
GIN COVE, JAMES ROSS ISLAND (64°03`S, 58°25`W)	NE	2
GONZ. VIDELA/WATERBOAT PT. (64°49`S, 62°51`W)	NW	116
GOSLING ISLANDS (60°39`S, 45°55`W)	SS	2
GREAT WALL (STATION), KGI	SS	3

HANNAH POINT, LIVINGSTON IS. (62°39`S, 60°37`W)	SS	203
HANUSSE BAY (66°37`S 67°30`W)	SW	2
HEIM GLACIER, ARROWSMITH PEN.(67°28`S 66°55`W)	SW	1
HEROINA ISLAND, DANGER ISLANDS (63°25`S 54°40`W)	NE	1
HEYWOOD ISLAND (62°20`S 59°41`W)	SS	1
HOLLUSCHICKIE BAY, JAMES ROSS ISLAND (63°59`S 58°16`W)	NE	1
HOPE BAY (ESPERANZA) (67°28`S 66°55`W)	NE	68
HOVGAARD ISLAND (65°08`S 64°08`W)	NW	10
HYDRURGA ROCKS (64°08`S 61°37`W)	NW	13
JOINVILLE ISLAND (63°15`S 58°16`W)	NE	6
JUBANY (STATION), POTTER'S COVE (62°14`S 58°42`W)	SS	18
"KELSEY BAY" James Ross Island (64°S 58°16`W)	NE	1
KING SEJONG (STATION),	SS	3
KINNES COVE, JOINVILLE ISLAND (63°22`S 56°33`W)	NE	1
LAGARRIGUE COVE, ORNE HARBOR (64°39`S 62°34`W)	NW	1
LION'S RUMP (62°08`S 58°07`W)	SS	17
MACARONI POINT, DECEPTION IS. (62°54`S 60°32`W)	SS	1
MARTEL INLET, ADMIRALTY BAY (62°05`S 58°22`W)	SS	1
MELCHIOR ISLANDS (64°19`S 62°57`W)	NW	11
MIKKELSEN HARBOR, TRINITY ISLAND (63°54`S 60°47`W)	NW	15
MOUNT SCOTT, GIRARD BAY (65°09`S 64°03`W)	NW	1
MT. MILL, WADDINTON BAY (65°15`S 64°03`W)	NW	1
MURRAY HARBOR, MURRAY IS. (64°02`S 61°34`W)	NW	1
NEKO HARBOR, ANDVORD BAY (64°50`S 62°33`W)	NW	83
ORCADAS/SCOTIA BAY/LAURIE IS. (60°46`S 44°40`W)	SO	20
ORNE HARBOR (64°37`S 62°32`W)	NW	4
ORNE ISLANDS (64°40`S 62°40`W)	NW	11
PALMER STATION, ANVERS IS. (	NW	78
PARADISE BAY (64°51`S 62°54`W)	NW	59
PAULET ISLAND (63°35`S 55°47`W)	NE	151
PENDULUM COVE, DECEPTION IS. (62°56`S 60°36`W)	SS	219
PENGUIN ISLAND (62°06`S 57°54`W)	SS	83
PENGUIN POINT, SEYMOUR ISLAND (64°51`S 56°43`W)	NE	5
PETERMANN ISLAND (65°10`S 64°10`W)	NW	198
PETREL COVE, DUNDEE IS. (63°28`S 56°13`W)	NE	4
PITT ISLANDS (65°26`S 65°30`W)	SW	1

PITT POINT (Victory Glacier) (63°51'S 58°22'W)	NE	1
PLENEAU ISLAND (65°06'S 64°04'W)	NW	66
POINT MARTIN (60°47'S 44°41'W)	SO	1
POINT THOMAS, EZCURRA INLET (62°10'S 58°34'W)	SS	1
POINT WILD, ELEPHANT IS. (61°06'S 54°52'W)	SS	12
PORT CHARCOT, BOOTH ISLAND (65°04'S 64°W)	NW	1
PORT LOCKROY (also Goudier and Jougla pt) (64°49'S 63°30'W)	NW	216
PORTAL POINT, CHARLOTTE BAY (64°03'S 61°46'W)	NW	46
PRESIDENTE FREI (STATION)	SS	41
PRIMAVERA (STATION) CIERVA COVE (64°09'S 60°53'W)	SS	16
PROSPECT POINT, GRAHAM LAND (66°01'S 65°21'W)	SW	9
ROBERT POINT, ROBERT IS. (62°28'S 59°23'W)	SS	3
ROSAMEL ISLAND (63°34'S 56°17'W)	NE	2
ROTHERA (STATION), ADELAIDE ISLAND (67° 34'S 68°08'W)	SW	6
RUM COVE, JAMES ROSS ISLAND (64°06'S 58°25'W)	NE	1
SAN MARTIN (STATION)	SW	3
SEYMOUR ISLAND (64°28'W 56°46'W)	NE	6
SIGNY ISLAND (STATION) (60°16'S 62°55'W)	SO	5
SMALL ISLAND, CHRISTIANIA ISLANDS (64°S 61°27'W)	NW	1
SMALL PEAK, ERRERA CHANNEL	NW	1
SNOW HILL ISLAND (64°28'S 57°12'W)	NE	10
SOUTH BAY, LIVINGSTON ISLAND (62°40'S 60°28'W)	SS	1
SPIGOT PEAK, ORNE ISLAND (64°38'S 62°34'W)	NW	1
SPRING POINT, BRAILMONT COVE (64°18'S 61°03'W)	NW	1
STONINGTON ISLAND (68°11'S 67°W)	SW	3
TAKAI PENINSULA (65°33'S 64°41'W)	SW	1
TELEFON BAY, DECEPTION IS. (62°56'S 60°40'W)	SS	45
TENIENTE MARSH (STATION)	SS	9
TORGERSEN ISLAND (64°46'S 64°05'W)	NW	39
TURRET POINT , KING GEORGE BAY (62°05'S 57°55'W)	SS	9
USEFUL ISLAND (64°43'S 62°52'W)	NW	1
VERNADSKY STATION	NW	31
VIEW POINT, DUSE BAY (63°33'S 57°22'W)	NE	4
WHALERS BAY, DECEPTION IS. (62°59'S 60°34'W)	SS	296
YALOUR ISLANDS (65°14'S 64°10'W)	NW	16
YANKEE HARBOR, GREENWICH IS. (62°32'S 59°47'W)	SS	41

Appendix 6

Ship and Yacht visits to Cuverville Island during the 1992/93, 1993/94 and 1994/95 summer season.

DATE	VESSEL NAME	NO ASHORE	COMMENTS
7 December 1992	World Discoverer	20	our landing
14 December 1992	Columbus Caravelle	97	
24 December 1992	Explorer		95 Zodiac cruise
26 December 1992	Vavilov	62	
26 December 1992	Columbus Caravelle		120 Zodiac cruise
2 January 1993	Ocean Princess	270	Staggered landing
2 January 1993	Professor Molchanov	32	
5 January 1993	Kotick II	8	Yacht
6 January 1993	Vavilov	42	
10 January 1993	Columbus Caravelle		120 on Zodiac tour
14 January 1993	Explorer	58	
15 January 1993	Professor Molchanov	38	
19 January 1993	Vavilov	58	Illiria diverted due to Vavilov visit
22 January 1993	Explorer	74	
24 January 1993	World Discoverer	128	
25 January 1993	Columbus Caravelle	145	
27 January 1993	Pelagic	9	Greenpeace visit
28 January 1993	Professor Molchanov	30	
31 January 1993	Vavilov	64	
2 February 1993	World Discoverer	110	
5 February 1993	Explorer	55	
7 February 1993	Illiria	100	Visited Orne Island also
10 February 1993	Professor Molchanov	38	
13 February 1993	World Discoverer	4	Mail drop only
13 February 1993	Vavilov	44	
14 February 1993	Explorer	58	
17 February 1993	Illiria	100	Orne Island also
20 February 1993	World Discoverer	100	

20 February 1993	Columbus Caravelle		100 on Zodiac tour
22 February 1993	Professor Molchanov	38	
28 February 1993	Explorer	90	
2 February 1993	World Discoverer	128	Team pick-up
TOTAL	35 VISITS	1950	

23 November 1993	Columbus Caravelle		Drop off of team 124 Zodiac tour
4 December 1993	Columbus Caravelle		125 Zodiac tour
10 December 1993	Professor Molchanov	24	
13 December 1993	James Clark Ross	12	BAS research vessel
14 December 1993	Explorer	80	
15 December 1993	Columbus Caravelle		157 Zodiac tour
21 December 1993	Explorer	60	
22 December 1993	Vavilov	62	
	Ioffe	72	
23 December 1993	Marco Polo	4	Drop off team members
24 December 1993	Professor Molchanov	37	
30 December 1993	Kapitan Khlebnikov	105	
8 January 1994	Professor Molchanov	34	
11 January 1994	Damien II	9	Yacht
12 January 1994	Columbus Caravelle	160	staggered landing
15 January 1994	Kapitan Khlebnikov	70	
15 January 1994	Ioffe	70	
18 January 1994	Pelagic	9	Yacht
19 January 1994	Pelagic	3	
	Bremen	120	staggered landing
21 January 1994	Professor Molchanov	20	
25 January 1994	Ioffe	79	
27 January 1994	Kapitan Khlebnikov	104	
28 January 1994	Bremen	120	staggered landing
1 February 1994	Professor Molchanov	22	
3 February 1994	Explorer	80	
4 February 1994	Vavilov	74	
5 February 1994	Pelagic	3	Yacht
7 February 1994	Columbus Caravelle	100	

8 February 1994	Bremen	130	staggered landing
10 February 1994	Explorer	79	
	Ioffe	78	
13 February 1994	Vavilov	79	
14 February 1994	Professor Molchanov	17	
18 February 1994	Ioffe	75	
19 February 1994	Metapassion	2	Yacht
20 February 1994	Metapassion	2	Yacht
23 February 1994	Explorer	74	
25 February 1994	Vavilov	47	Team pick-up
TOTAL	39 VISITS	1789	
28 November 1994	Explorer	92	Team drop-off
8 December 1994	Alla Tarasova	50	
10 December 1994	Livonia	35	
12 December 1994	Professor Molchanov	28	
13 December 1994	World Discoverer	120	
14 December 1994	Vavilov	72	
17 December 1994	Khromov	38	
19 December 1994	Livonia	33	
21 December 1994	World Discoverer	126	
23 December 1994	Professor Molchanov	18	
24 December 1994	Vavilov	58	
25 December 1994	Alla Tarasova	60	
26 December 1994	Dranytsin	91	
26 December 1994	Explorer	85	
27 December 1994	Livonia	28	
2 January 1995	Vavilov	75	
3 January 1995	Professor Molchanov	22	
4 January 1995	Alla Tarasova	95	
	Ioffe	75	
6 January 1995	Professor Khromov	35	
9 January 1995	Metolius	13	Yacht
10 January 1995	Vavilov	75	
	Hanseatic	165	Staggered landing
12 January 1995	World Discoverer	125	Staggered landing

14 January 1995	Explorer	94	
17 January 1995	Alla Tarasova	94	
18 January 1995	Vavilov	78	
21 January 1995	Livonia	38	
	Ioffe	78	
24 January 1995	Explorer	74	
	Alla Tarasova	98	
26 January 1995	Vavilov	78	
29 January 1995	Livonia	35	
31 January 1995	Professor Molchanov	30	
3 February 1995	Vavilov	76	
4 February 1995	Ioffe	76	
	Explorer	98	
5 February 1995	Itasco	9	Yacht
5 February 1995	Maupiti	4	Yacht
6 February 1995	Professor Khromov	38	
7 February 1995	Professor Molchanov	38	
13 February 1995	Metapassion	3	Yacht
	Cryssalide	5	Yacht
14 February 1995	Ioffe	79	
	Livonia	38	
15 February 1995	Explorer	95	
17 February 1995	Professor Khromov	33	
20 February 1995	Vavilov	78	
22 February 1995	Hanseatic	165	Staggered landing
24 February 1995	Livonia	32	
	Ioffe	73	
28 February 1995	Professor Khromov	30	
TOTAL	52 VISITS	3148	
CUMULATIVE TOTAL	126 VISITS	6887	

Appendix 7

Common and latin names of bird and mammal species appearing in text

Common Name	Latin name
Emperor penguin	*Aptenodytes forsteri*
Adélie penguin	*Pygoscelis adeliae*
Chinstrap penguin	*Pygoscelis antarctica*
Gentoo penguin	*Pygoscelis papua*
Rockhopper penguin	*Eudyptes crestatus*
Macaroni penguin	*Eudyptes chrysolophus*
Southern giant petrel	*Macronectes giganteus*
Southern fulmar	*Fulmarus glacialoides*
Antarctic petrel	*Thalassoica antarctica*
Pintado petrel (also cape petrel)	*Daption capense*
Snow petrel	*Pagodroma nivea*
Wilson's storm-petrel	*Oceanites oceanicus*
Black-bellied storm-petrel	*Fregatta tropica*
Blue-eyed shag	*Phalacrocorax atriceps*
Snowy sheathbill	*Chionis alba*
South polar skua	*Catharacta maccormicki*
Brown skua	*Catharacta lonnbergi*
Dominican gull	*Larus dominicanus*
Antarctic tern	*Sterna vittata*
Antarctic fur seal	*Arctocephalus gazella*
Crabeater seal	*Lobodon carcinophagus*
Weddell seal	*Leptonchyotes weddelli*
Leopard seal	*Hydruga leptonyx*
Southern elephant seal	*Mirounga leonina*
Ross seal	*Ommatophoca rossi*
Minke whale	*Balaenoptera acutorostrata*
Humpback whale	*Megaptera novaeangliae*
Killer whale	*Orcinus orca*